EXCURSIONS AROUND AIX-LES-BAINS

COMPILED BY

WILLIAM MORRIS DAVIS

Professor of Geology, *Emeritus*, Harvard University
Honorary Member of the French Alpine Club

PUBLISHED FOR THE
Y. M. C. A. NATIONAL WAR WORK COUNCIL
BY THE
APPALACHIAN MOUNTAIN CLUB
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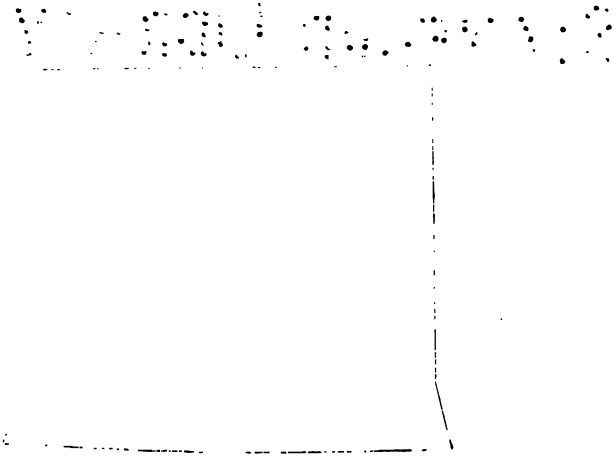


PREFACE

THIS guide book, published at the suggestion of the National War Work Council of the Y. M. C. A., in an edition of 2000 copies, is a gift to the Officers and Men of the American Expeditionary Forces in France from the Appalachian Mountain Club of Boston.

The members of the Club have, one or another of them, visited many mountain ranges in various parts of the world. They remember with satisfaction the invigorating exercise of arduous ascents on steep slopes; they recall with pleasure the exhilaration of wide views from lofty summits. They now rejoice to think that their soldier-compatriots may, while on leave from military duties, enjoy the recreation of walking and climbing in the beautiful mountains of the French Alps around Aix-les-Bains.

May this little book be a helpful companion on many delightful excursions.

W. M. D.

CAMBRIDGE, MASS.
May, 1918.

EXCURSIONS ABOUT AIX-LES-BAINS

AIX-LES-BAINS AND ITS REGION

THE town of Aix-les-Bains (altitude, 260 m., population, about 9000) in the ancient province of Savoy lies between the southernmost ranges of the Jura mountains and the western ranges of the Alps in southeastern France. Nearby on the west is Lake Bourget (alt. 231 m.), a beautiful sheet of water 12 k. long, trending north and south between mountain ridges on either side. The mountains hereabouts rise from 1000 to 1500 m. (3300 to 5000 ft.) above sea level, and are therefore higher than any mountains that many Americans, whose homes are in the central United States, have ever known. The snowy ranges of the Alps, which may be seen to the east from favorable points of view, reach altitudes of 3000 or 3500 m., and are therefore much higher than any summits in the United States east of the Rocky mountains.

Aix-les-Bains is 450 k. southeast of Paris, 80 k. east of Lyons, 60 k. south of Geneva, and 275 k. north of Marseilles. The boundary between France and Italy trends irregularly southward along the crest of the Alps about 80 k. to the east. The river Rhone, coming from Lake Geneva where France adjoins Switzerland, passes near the north end of Lake Bourget, and about 30 k. farther southwest turns to a northwest course in a strong V-like bend through the Jura mountains before flowing west across a more open country to its confluence with the Saône; there Lyons is situated at the base of the Central Highlands. The Rhone then flows southward along the eastern base of the highlands for 140 k., and in 280 k. reaches the Mediterranean sea.

The small delta plain on which Aix-les-Bains is built lies at the base of a slope which rapidly rises eastward to a mountainous height (1500 m.). The situation as well as the name of the town — the Baths at the Waters — is determined by warm springs (44°–47° C. or 111°–117° F.); the baths have made the town a popular resort for over a century. The settlement of the surrounding district is of ancient date. The remains of prehistoric lake dwellings have been found near the shores of Lake Bourget and are now preserved, along with many relics of Roman occupation, in the local museum. Already in the third or fourth century of the Christian era the town was populous and rich enough for the erection of a fine stone arch, still well preserved.

Those who wish to gain an understanding of mountain scenery should read the chapter on the " Origin of Alpine Topography " before ascending to the higher points of view described in the following excursions. The lack of previous study of geology or physiography should here be no hindrance, for it is precisely in view of the abundant facts of internal structure and of surface form presented by the mountains and valleys around Aix-les-Bains that the theories of geology and physiography are best learned. The accounts of excursions serve as guides to the feet and as aids to external eyesight: the explanations of Alpine topography serve as guides to the head and as aids to thoughtful insight. The greatest enjoyment of mountain ascents comes when the mind is as alert as the body.

GENERAL SUGGESTIONS FOR MOUNTAIN EXCURSIONS

In order to gain a clear idea of the district about Aix-les-Bains and to plan a series of excursions from which much interest and exhilaration may be gained, the visitor should lose no time in ascending to a near-by hill or ridge crest (see Excursions 1 and 2), whence a good view may be obtained and the general lay of the land examined. One who has already made some such ascents can do good service to later comers by leading them as promptly as possible to the best points of view that he has enjoyed.

Do not make high mountain ascents alone. If a guide is engaged consult the local tariff and agree upon his charge before starting. When paying him at the end of a trip add about 10 % of the charge for a tip or " pourboire," and pay it cheerfully as a matter of course. If one guide is taken for a party the tip should be increased. Sign posts abound in the vicinity of Aix; no guide is needed on the lower ridges and mountains. Excursions are best made in small parties of three or five. If a large party sets out, it should be divided into squads of ten or fewer members. Those who wish to make the excursion without stopping should join a separate squad from those who wish to stop frequently for photographing or sketching.

Each squad should, if possible, have an experienced leader; he should make a list of the members, head the line of march on narrow paths, and set the proper pace, slow for ascents, faster for descents; a shrill whistle will aid in summoning his party together. A marshal should follow in the rear to round up the stragglers. Before setting out on a long mountain walk, place the members of a squad in a circle and let each member take note of his two neighbors, one on his right, one on his left, for whose presence he is to be responsible whenever the march begins after a halt: each member will thus be looked for by two others. Once on the road,

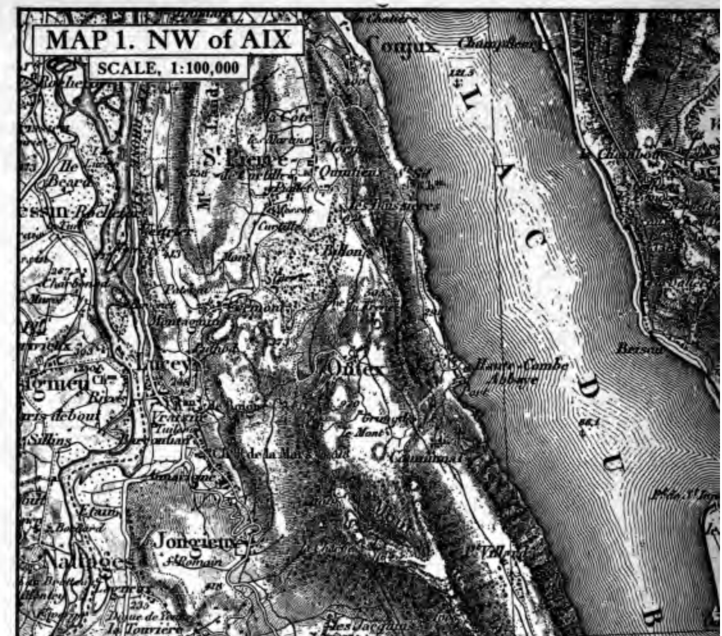
keep together; those who wander away from their squad cause vexatious delays. The marshal's report, "All present and ready to start," is especially important when a descent begins. If a member wishes to leave his squad after low ground is reached, he should so report to his leader.

Clothing should be easy fitting, so that discomfort shall not be added to fatigue. Even in warm weather, a coat will often be wanted on a ridge crest, or mountain top: it can be best carried as follows: — Sew the middle of a 30- or 35-inch piece of strong tape inside of the back of the collar; sew the ends of the tape to the bottom of the arm holes: pass the arms through the loops of the tape, and let the coat hang loosely on the back; it will thus be held so that nothing will fall from the pockets and the arms and hands will be free. A light water-proof cloak may be wanted. Hob-nailed shoes and Alpenstocks are always helpful; they are indispensable in high mountain excursions. A pocket compass is useful in selecting paths by direction. A light pocket lunch should be carried, in case return is delayed. Avoid drinking from streams below villages and from village wells on low ground. During the warmer season start at sunrise or earlier, so as to have the cool morning air for uphill walks; rest in the afternoon.

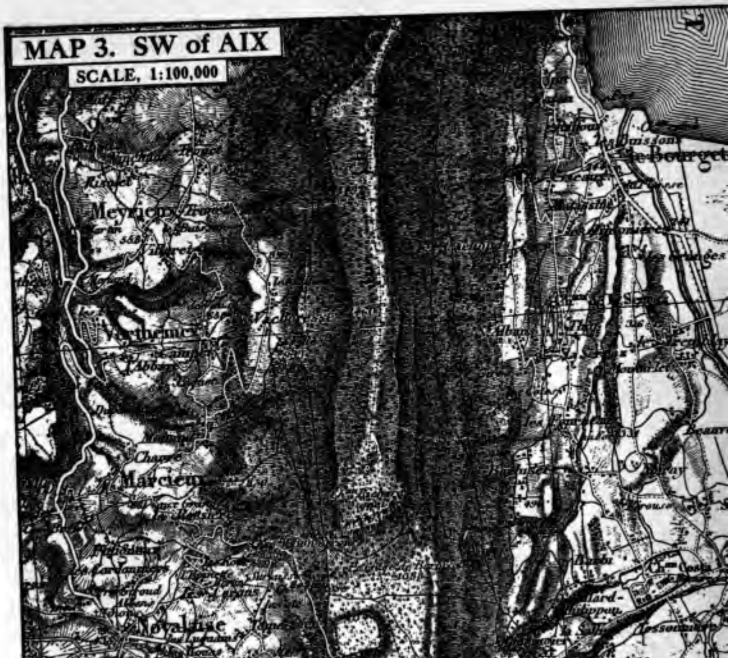
Walk quietly, especially when passing through villages. Walking along railways is forbidden in France. Do not race with one another, especially in descents. Do not roll loose rocks down from ridge tops. While walking uphill, adopt a moderate pace that can be steadily maintained, and keep going. Inexperienced climbers are apt to walk too fast at first and, on feeling the strain of a long ascent, to become discouraged and "give it up"; or if they persist to the top, they may be tempted to accept bodily fatigue as an excuse for the indolent contemplation of a view, the full enjoyment of which calls for active observation. Let these beginners remember that many others have shared their feelings, but have learned to regard temporary fatigue as a misleading adviser. There is no harm done if one becomes somewhat tired; exhaustion is prevented by reducing the pace when moderate fatigue begins. Let the mind rest on agreeable thoughts while the body is working steadily during a climb; when the summit is reached, let the body rest as comfortably as possible while the mind works actively in a conscious examination of the view. Avoid the error of neglecting the view after making a great effort in attaining the view point.

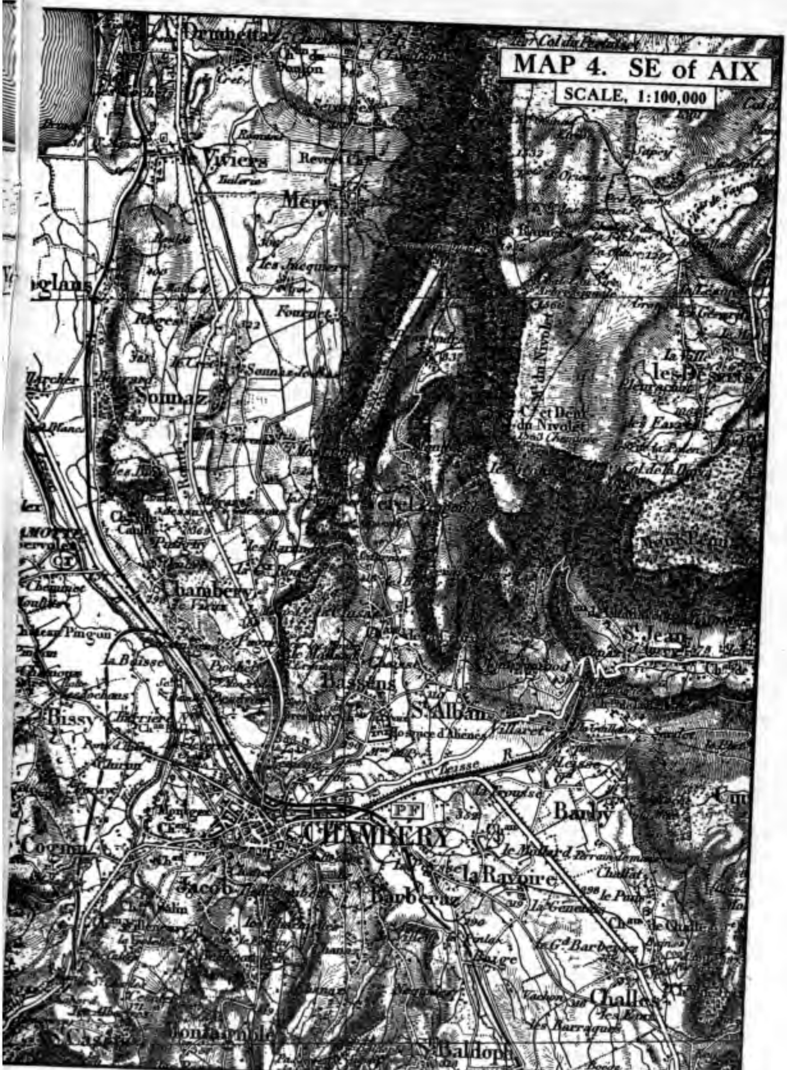
An ascent of 400 or 475 m. an hour may ordinarily be made on a mountain path; where paths are wanting, ascent is much slower; where rock climbing is necessary, slower still. Descent is usually much shortened by cut-offs at zigzags in the path of ascent: the time of descent may be only a half or a third of that required for ascent. The time noted for excursions below does not include stops: additional time should be allowed for leisurely rests at good points of view.

Make a practice of keeping your bearings and of estimating distances and heights, all to be verified by reference to a map. The local maps here included are reduced to a scale of 1 : 100,000 (1 centimeter on the map = 1 kilometer on the ground, or about $\frac{2}{3}$ inch = 1 mile), from the


MAP 1. NW of AIX
SCALE, 1:100,000
Conjux
St Pierre
Ontex
Haute-Combe
Abbaye
Jongieux
Billième
la Chapelle
St Jean
de Chevelu
Chevelu
St Paul
Bourdeau
LAC DU BOURGET
Richardon
B.t Saumont
les Bernards
Yenne
Mollard Noir


MAP 2. NE of AIX
SCALE, 1:100,000
ALBENS
St Girod
Chatuaz
La Biolle
St Ours
St Maynard
Epersy
St Offenge
Montcel
Pugny
Mouxy


MAP 3. SW of AIX
SCALE, 1:100,000
Meyrieux
Verthemex
Marcieux
Novalaise
le Bourget
Curtine
la Villette
Villard Peran
St. Alban
de Montbel



MAP 4. SE of AIX

SCALE, 1:100,000

French army staff map on a scale of 1 : 50,000. The maps on the four preceding pages show the district around Aix-les-Bains, which is represented near the southwestern corner of Map 2. The NE and SE quarters of sheet 169 and the NW and SW quarters of sheet 169 *bis* of the 1 : 50,000 army staff map are helpful for local excursions; sheets 48 and 54 of the 1 : 200,000 map of the geographical service of the army will be found useful on more distant excursions. When a mountain top is reached, identify in the landscape a good number of points represented on the maps.

Carry a camera and a note book. Do not attempt extensive views unless with a camera especially adapted to such work; select local views and " bits " of landscapes or village scenes, and give special care to finding a good foreground; when villagers and peasants are included, do not have them all look at the camera, unless portraits are wanted, Descriptive notes and sketches made on the spot stimulate observation, increase enjoyment, and prolong memory. Detailed plans of parts of paths, not sufficiently shown on the maps here presented, will be valuable aids to later visitors: draw them out and hang them up where they can be seen. The more closely an observer enters into an appreciative and sympathetic understanding of what he sees, the greater recreation of mind and body will follow from his excursions.

Abbreviations: Aix for Aix-les-Bains (not to be confused with the city of Aix, near Marseilles). N, S, E, W, north, south, east, west; alt., altitude; m., meters (1 m. = 3.28 feet); k., kilometer (1 k. = $\frac{5}{8}$ mile); h., hour; Mt., Mont (Mount); Mtne., Montagne (Mountain); Exc., excursion; htl., inn, rstt., hotel, inn, restaurant; pop., population; ry, railway; sta., station.

EXCURSIONS NEAR AIX-LES-BAINS

THE following excursions are a few of the many that may be made from Aix. They are planned so as to introduce the visitor to the general features of the district. The first excursion, or the second as far as the Croix de la Biolle, may be made to advantage on the afternoon of arrival: the third or the fourth should not be delayed later than the day after arrival by visitors in good health, if they wish to gain the greatest enjoyment from other excursions during the rest of their stay. *Read the account of an excursion before undertaking it. Inquire, before setting out on any of the longer excursions, whether restaurants in out-of-the-way places and hotels or inns at villages recommended for the night are open. Consult time-tables for all railway excursions.*

Excursion 1. *Maps 2 and 4. Tresserve*, a village on a low ridge, 2 k. SW of Aix, about 100 m. above Lake Bourget (alt. of lake, 231 m.). The best view is from the ridge crest, 338 m., W of the village, where a fine prospect is opened over the lake and to the mountain ridges E and W. In the afternoon of warm sunny weather, return should be made by a lane along the E base of the ridge, to which descent may be made at various points; in the morning or on cloudy days of warm summer weather, return may be made by a road along the lake shore, to which a winding lane descends rapidly from the S end of Tresserve village, and to which two forks of the village road descend more gradually farther S. Distance out and back, from 5 to 10 k.; time from 1 to 2 h.

Exc. 2. *Maps 2 and 1. Mt. de Corsuet*, a ridge belonging to the Jura mountains, N of Aix. Follow the main Geneva road (Route nationale 201, de Chambéry à Genève), or go by electric railway alongside of this road, N 2.5 k.; cross to the W side of Sierroz (Séroz) brook, and 350 m. beyond, where a lane on the left turns back to the SW, take an ascending path to the NW. The Croix de la Biolle, 817 m., on the crest of Mt. de Corsuet, 6 k. or 2½ h. from Aix, offers an extensive prospect in all directions. On the return, a path branches to SSW, 1.4 k. S of the summit, and descends 2 k. to the village of Brison-St. Innocent (inn) near the lake, whence a main road leads to Aix, 1½ h. from the summit.

This excursion may be prolonged by following the ridge crest or the adjoining slope NW 2.5 k. or 1 h.? to a somewhat higher point, 842 m. (There is no path along the ridge crest here; inquire before starting from Aix as to best course to take.) Descent may then be made on either slope by a path that crosses the ridge just S of the 842 m. summit: on the W, the path soon turns S and slants down the ridge flank. Or the ridge may be followed 1.5 k. still farther NW to the high village of Chambotte (rstt), where a road crosses a depression of the crest. Here descent may be made S by a path on the W flank of the ridge to a main road along the lake shore, 9.5 k. to Aix, but this route should be avoided on warm sunny afternoons: or E by a road to the village of St. Germain, whence a SSE and S path along the W side of a valley is a shorter return than a road along the E side; but both rejoin the main Geneva road on the way back to Aix. Distance to Chambotte and back, 20–22 k.; time, 6–6½ h.

Or instead of turning S on the slope W of Chambotte, follow a slanting road N 4.5 k. along the flank of the ridge to the low ground N of Lake Bourget; then loop back SW 0.8 k. to Chindrieux sta., and return by train S 14 k. to Aix.

An attractive supplement may be made to the above excursion over the same ridge about 5 k. farther N, where it is called the Mtne. de Cessens. Take train from Aix N 14 k. along the border Lake Bourget to Chindrieux sta. at N end of lake; the ancient castle of Chatillon is on a knob, 268 m., 0.5 k. to the SW. Walk N 2 k. from sta. to Chindrieux village; turn E 0.3 k. and N 0.5 k. on the mountain flank; then ascend NE by a zigazg lane, 1.6 k. in direct distance, to the upper slope, where the lane turns S 1.7 k. to the Col du Sapenay, 931 m.; continue by path and lane S 2.8 k. along the slope above the cliffs with fine view over the lake, to a second col at the ruined Towers of Caesar, 852 m. (rstt.); fine view from a higher point on the ridge to N. Turn E on a lane (the flat paving of an ancient Roman road is seen here) and descend 0.7 k. to Cessens; continue E 0.8 k., then S 2.4 k. to St. Germain, and return to Aix as above. Total distance from Chindrieux sta. to Aix, about 24 k.: the last 6 k. may be made by train.

Exc. 3. *Maps 2 and 4. Mt. de la Cluse and the Grand Revard.* The Grand Revard is a superb point of view on the precipitous face of the Mt. de la Cluse, a subalpine range, 1450–1550 m., that rises 5 k. E of Aix and extends 8 k. S to the Dent du Nivolet, which overlooks the city of Chambéry. Ascent to the Grand Revard on foot, 8 k. in 4 h.; descent by same path, 3½ h. or less (ascent by inclined ry., see below). Follow an ascending road E from Aix through the villages of Mouxy, 2 k., and Mentens, 3 k.; continue 1.5 k. by a path which rises, partly in zigzags, to a bench where it turns S 1.3 k. beneath the summit cliffs; then ascend E to a notch, the Col du Pertuiset, 1407 m.; here a good spring is found. The path turns N from the col, mounting slowly over highland pastures amid pine groves, and in less than 1 k. reaches an Alpine Club shelter and some chalets or mountain huts; 1.5 k. farther N an easy ascent leads to the Grand Revard, 1568 m. (htl., rstt.) A superb view is here opened, including Mt. Blanc, E 80 k., from which the snowy Alps extend far S; the Central Highlands are seen W 100 k.

The descent may be varied by taking a path NE 2.5 k. to La Cluse and N 4 or 5 k. to St. Offenge; then by road NW 2 k., SW 6 k. (passing the falls and gorge of the Sierroz near Grésy), and S 4 k. to Aix in 5 h.; or from La Cluse N 2 k. then W and SW 7 k. by paths and lanes along the mountain flank, past St. Victor and Trevignin to Aix, 4 h. Or in the

other direction, the mountain crest may be followed S past the Col du Pertuiset 5.2 k. to another col beyond which rises the Mt. des Ramées, 1422 m.; turn W in the col and descend by a zigzag path to a N–S path on a bench; here turn N 300 m., then descend again through a cleft by a direct path to the village of Méry, whence various roads lead NW and N 6 k. to Aix in 5 h. As all the descending paths on the W slope of the mountain are exposed to strong sunshine in summer afternoons, it is well, if time allows, to spend the day on the highland in excursions on the gradual slope to the E of the crest. A circuit E 4.5 k. over a ridge to the village of La Magne, then S 3 k. by road over the broad Col de Planpalais, W by lane and path 4 k. to the mountain crest, and N 3 k. to the Grand Revard again, may be recommended. Pass the night in the summit hotel, and descend to Aix early the next morning when the precipitous W slope is in the shade.

The ascent from Aix to the Grand Revard may also be made by an inclined railway, first E, then ENE, then SSW to the summit in 1¼ h. The chief advantage of the ascent by rail is that time is then allowed for extending the excursion S along the mountain crest to the Dent du Nivolet, whence descent may be made by various paths to Chambéry, and return by train to Aix in one day. In this case, follow the path S from the Grand Revard to the Col du Pertuiset, and continue nearly to the Mt. des Ramées, 5.2 k., where a steep descent to W leads down to the village of Méry, as noted above. Here the best path turns E 1.3 k.; then SSW 3 k. to the Dent du Nivolet, 1553 m., 9.5 k. or 2½–3 h. from the Grand Revard. The cliff face makes an angle at this point between W and S, and a superb view is opened S across the breach of Chambéry to the Mtne. de la Grande Chartreuse, the SW extension of the subalpine range to which the Dent du Nivolet and the Mt. de la Cluse belong; also SSE across the great valley of the Isère, locally known as the Graisivaudan, to the high mountains beyond.

Descent may be made by a crevice in the cliffs, 0.5 k. E of angle, to the chalets of Le Nivolet on a bench (1200 m. ?), but this should not be attempted by inexperienced climbers without a guide: from Le Nivolet a more gradual descent by path, lane and road leads S and W to Chambéry, 7 k. (4 h. ?) from summit. Another way of descent leads E near the sloping cliff top for 2 k. to a depression, the Col de la Doria, 1087 m., beyond which the cliffs rise again to the S in Mt. Pennay, 1371 m.; a rocky path (may not be in good condition; inquire at chalets 0.5 k. to N) leads almost W 0.5 k., obliquely down the cliffs, then S 2.3 k. to main road, 550 m., near St. Jean d'Arvey; follow the road WSW 5.5 k. to Chambéry; 4½ h. (?) from summit.

An easier descent from the Dent du Nivolet follows a roundabout course: first, return 1–2 k. along the path of approach; turn E across sloping pastures and woodland 2 k. to a hamlet, whence a lane and various paths descend E 1 k. to the village of Les Déserts, 940 m. (inn): here take the main road, which comes from the highland of Les Bauges (see Exc. 10) on the N and continues down a sloping bench on the right (W) of the Leisse, a torrential stream, first S 4 k. then W 3 k. passing St. Jean d'Arvey, 578 m. (inn), and other villages beneath the cliffs of Mt. Pennay, 1370 m., and finally 5 k. WSW mostly across low ground to Chambéry, 300 m.; 16.5 k. or 4 h. from the Dent du Nivolet; 26 k. or 6½–7 h. from the Grand Revard. A car or carriage may be ordered beforehand at Chambéry to meet a party at Les Déserts. From Chambéry, N by train to Aix, 14 k., ½ h.

Exc. 4. *Maps 1 and 4.* *La Dent du Chat*, a knob, 1400 m., at the N end of the Mt. du Chat, one of the Jura mountains which rises to 1400–1500 m., SW of Lake Bourget, 5–10 k. from Aix. The ascent of the Dent is best made from the village of Le Bourget (htls.), at the S end of the lake: this point may be reached from Aix by road, S 4.7 k., and W 3.8 k.; or S by train 4.7 k. to Le Viviers, then W by road 3.3 k.; or by boat: take street railway from Aix W 1.5 k. to Port de Cornin on margin of delta plain, boat SW 5 k. to Port du Bourget, road S 1 k. to village. As the ascent from Le Bourget, 240 m., is mostly on a steep slope facing E it should be made at as early an hour as possible in warm weather: hence in summer go to Le Bourget in the late afternoon, spend the night there, and start out before sunrise the next morning. Ascend W by lane and path on S side of a ravine 1.4 k. to a bench, 490 m. alt.; follow path on the bench N 1.5 k.; then ascend W by zigzags to a high level path, and turn N along it (an Alpine Club shelter is on this path near a spring), rising obliquely for 1.3 k. to the E base of the cliff-rimmed Dent; the final climb to the summit is aided by an iron railing set in the rock; ascent, 3 h. from Le Bourget; descent by same path, 2 h. A fine view is opened across Lake Bourget to the cliffs of the Mt. de la Cluse and the higher mountains beyond; also, SE past Chambéry and across the valley of Graisivaudan to the great Chain of Belladonne, 2500 m., and beyond to the snowy crest of the Grandes Rousses, *3500 m., as well as* far over the lower district to the W (see Exc. 6).

The highest point of the Mt. du Chat, 1479 m., is about 0.5 k. SSW of the Dent.

The Dent du Chat may be ascended more directly by crossing the lake, 231 m., from the Port de Cornin (see above), SW 2.7 k. to Bourdeau landing; the boat should be retained to meet the party on the return trip. Ascend by steep path to Bourdeau village (htls. rstt.; ancient castle, restored); continue ascending by NW path to a highway, the "Route de France," that leads from Chambéry to Lyons; the zigzags (htl. at last angle overlooking lake) may be shortened by foot paths until the road turns W and leads directly to the Col du Chevelu, 638 m., 2.5 k. or 1 h. from lake. The path to the Dent, distant 2.5 k., here turns SSW, at first following the steep slope W of the ridge crest, then crossing the crest in notches; as the path may be indistinct on slopes of loose rock, inexperienced climbers should take a guide. Time for ascent from lake, nearly 3 h.; descent, 2 h. If those who ascend from Le Bourget wish to descend to Bourdeau, they should inquire before starting as to the condition of the path from the Dent to the Col du Chevelu, and take a guide if so recommended; a boat for returning across the lake should be engaged before leaving Aix.

Exc. 5. *Map 1. Mt. de la Charvaz*, overlooking Lake Bourget on W. Tramway from Aix NW 2.5 k. to Port de Puer on delta of the Sierroz; boat NW 6 k. to Abbey of Hautecombe on W side of lake. The Abbey was founded about 1130 and rebuilt 1824–43; the princes of Savoy were buried here from the twelfth century to 1778; the chapel, highly decorated and containing many statues, was retained by Italy when Savoy was ceded to France in 1860. Ascend SW by path 1 k. from landing to upland bench, alt. about 600 m., over cliffs. (Fine point of view on an isolated knob, 920 m., 1.5 k. to NW, near village of Ontex.) Follow path S along bench 5.5 k. — fine view over lake — to Gratteloup; just beyond, the path joins the "Route de France" (see Exc. 4), which comes up by zigazgs from S and turns W over the Col du Chevelu, 638 m. (Path from Gratteloup W 0.5 k. to col; fine view to W: return along road, small htl., at first angle overlooking lake.) Descend from Gratteloup S 1.5 k. by road and short-cut paths to Bourdeau (htls., rstt.); then E 0.5 k. by steep path to lake, where boat previously engaged crosses lake NE 2.8 k. to Port de Cornin; tramway 1.5 k. to Aix. Round trip, 4–5 h.

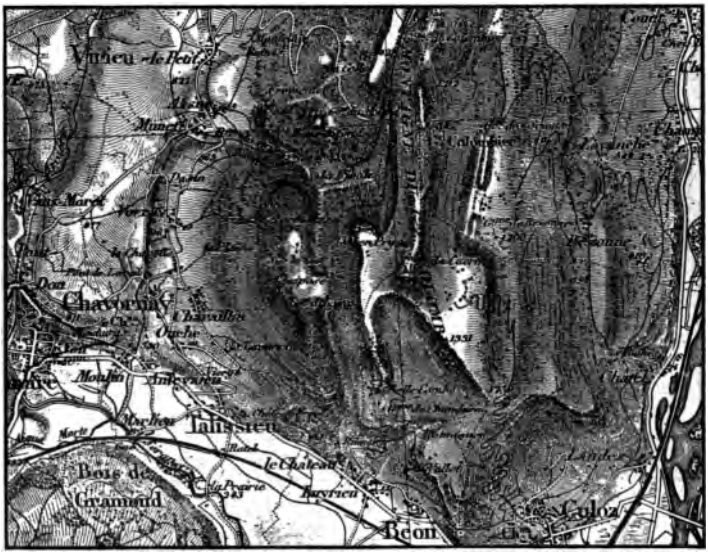
Exc. 6. *Gorge of the Rhone at Yenne.* Take train from Aix N 20 k. to Culoz, W 12 k. to Virieu-le-Grand, SSE 10 k. to Belley, 270 m. The cathedral of Belley was restored in 1864 in the style of

the fifteenth century, but the choir dates from 1413. Follow the main road E from sta. 0.7 k. to cross roads; there take a lane SE and E; it soon zigzags up the N end of the Mtne. de Parves, and thus reaches Montpellaz and Parves, about 520 m., on the E slope, 4 k. from ry. Several lanes and paths lead S; by keeping on the upper slope, the summit of the Mtne. de Parves, 629 m., may be reached in about 3 k.; fine view into the gorge of the Rhone on the S. Descend E and SE by path and lanes, 2.5 k. to a bridge over the Rhone where it enters the gorge; follow road E 0.5 k. to Yenne, 236 m. (htl.). Then (see Map 1) E by " Route de France " 8 k. to the Col du Chevelu, 638 m., at N end of Mt. du Chat; descend via Bourdeau to Lake Bourget as in excursion 5, and cross lake in boat previously engaged. Distance from Belley to Lake Bourget, about 22 k.

This walk may be shortened to about 16 k. by continuing on train from Belley S 4 k. to Brens; then follow the road S 1 k. and E 5 k. through the gorge of the Rhone to Yenne, etc. At the lower (W) end of the gorge, the fort of Pierre-Châtel, no longer occupied, was formerly a monastery, founded in the fifteenth century. Or the walk may be lengthened to about 26 k. by continuing on train from Brens S 10 k. to Murs, 220 m., near the great V-bend of the Rhone, whence the ascent NW and N via Izieu, 4 k. to the Mtne. d'Izieu, 760 m., gives a fine view of the Rhone valley; also E to the Jura ranges by Lake Bourget, SW over the open piedmont country, and N into the valley of the Gland where Prémeyzel village lies. Descend E 2.5 k. to small village of Fay; thence N 1.7 k. by road to Peyrieu, NE 4.5 k. nearly to Brens, and turn E as above.

Exc. 7. *Maps 4 and 3. Lake Aiguebelette and the Mtne. de l'Epine.* Railway from Aix S 14 k. to Chambéry; change train and run W 15 k. — direct distance 9 k. — (tunnel 3 k. under the Mtne. de l'Epine) to Aiguebelette, 400 m. ? (htls.) Here one may walk N 1 k. to the boat landing and take a boat 3 k. to the N end of the lake; walk back by the road near the W and S sides of the lake, 9 k., and return to Aix via Chambéry by train. A better plan is to ascend a path NE 3 k. from Aiguebelette to the col of the same name, 848 m., in the Mtne. de l'Epine, thus gaining a fine view E and W. Descend by a path NE 2 k. to St. Sulpice, 564 m., then by a picturesque road E via Cognin (ancient chateau) 6.5 k. to Chambéry, about 3½ h. from Aiguebelette: train to Aix. Or before reaching St. Sulpice, turn S 4 k. along the mountain flank to the cascade of Couz, 48 m. high: *take train from near-by* station to Chambéry, etc.

Exc. 8. *Map 5. Mtne. du Grand Colombier.* Train from Aix N 20 k. to Culoz, 240 m. (htl., rstt.). Ascend by a zigzag path N of the town to an upland, 1250 m. (direct distance from ry. sta. 4 k.); then up zigzags W to chalets, 1350 m. (direct distance, 1 k.); continue W 0.7 k. to the summit ridge of the Mtne. du Grand Colombier,



MAP 5. MONTAGNE DU GRAND COLOMBIER

1446 m., 3–4 h. from railway. Superb view of Alps, Jura, and the valley of the Rhone. Return by same path to Culoz sta., 2–2½ h.; train to Aix.

This excursion may be prolonged (inexperienced climbers should in this case engage a guide at Culoz) by following the mountain crest N 2 k. to a higher summit, 1534 m.; then descending NW and crossing ravine to zigzag road (short-cut paths) to Virieu-le-Petit, 3 k. from summit; then S 5 k. to Artemare (inn) in the valley and 1.5 k. farther to ry. sta. If desired the descent from the 1534 m. summit may be made more directly by a path (not so far N as the zigzag road) W 3 k. to Munet, then S 3.7 k. to Artemare, etc.

Exc. 9. *Map 6. Seyssel and the Gorge of the Fier.* Train from Aix N 34 k. to Seyssel (htl.), on the Rhone, which here flows S between the Mtnes. du Grand Colombier on W. and du Gros Foug on E. Cross the river by bridge, 255 m., and follow the highway S 3 k. to the Fier, which comes from the E and here issues from its 4 k. gorge (not to be confounded with the chasm of the Fier, 12 k. farther E): the gorge cuts off the small Mtne. des Princes, 942 m., on the N

MAP 6. SEYSSEL AND THE GORGE OF THE FIER

from the Mtne. du Gros Foug, 1051 m. A first-order highway runs through the gorge on the right (N) bank of the river: the arched structure of the mountain rocks is well revealed in the gorge walls. Near St. André (rstt.) at the upper (E) end of the gorge, a bridge over the Fier crosses to a third-order road which follows the left (SW) side of the open valley near the river, while the highway follows the right side farther from the river: both roads lead SE 8.5 k. to Rumilly, 350 m. (htls.), on the Chéran, 2.5 k. above its confluence with the Fiers, and 15.5 k. from Seyssel. From Rumilly, train, carriage or car, S 20 k. to Aix.

This excursion may be profitably lengthened, if lunch is carried, by turning W from the third-order road at the small village of Verlay 4 k. S of the St. André bridge, and ascending about 170 m. above the valley to a spur crest, where a lane leads S via the hamlets of Moye and Poisu 5 k. to Le Villard: or lunch at Rumilly and follow lanes SW and W via the hamlets of Survignes and Salongy to Le Villard, 4 k. Here ascend the Mtne. du Gros Foug (known as the Mtne. de Cessens and the Mt. de Corsuet farther S) W 2 k. to the summit village of Mont Clergeon; extensive view from a summit, 1031 m., nearby to NE. Descend W by zigzag lane 6 k. to Ruffieux (direct distance, 2.5 k.); take main road W 3.7 k across the marsh of Chautagne and the bridge over the Rhone; turn SW by lane alongside of railway 1.6 k. to Culoz sta.: train S 20 k. across marsh and along the E side of Lake Bourget to Aix.

Exc. 10. *Maps 7 and 8. The Valley of the Chéran.* A circuit of about 90 k., of which the most attractive part lies in the valley of the Chéran through the picturesque subalpine ranges of the Bauges east of Aix, follows roads of first and second order and may be made on foot in three days (or in two, if the last 40 k. are made by train), in carriage in two days, or by automobile in one. This excursion is highly recommended as giving an excellent view of village and pastoral life in the highlands of Savoy. It may be advisedly prolonged by local excursions from Le Chatelard and Ecole, as noted below.

From Aix N 3 k. (tramway) by main road; then take the right fork, cross the railway, and 4 k. from Aix turn NE below Grésy (the gorge and cascade of the Sierroz are near the turn); ascend the valley 8 k. to an open col, 523 m. The NE extension of the Mt. de la Cluse (see Exc. 3) rises to SE. Shortly beyond the col, the road turns E, passing Cuzy on a hilltop to N (the feudal castle of Fésigny is 0.5 k. NW of Cuzy), rounding the N slope of the mountain, and entering the transverse gorge of the Chéran high above the stream. A branch lane descends E 1 k. to the Pont de l'Abîme (rstt.), a suspension bridge 66 m. long, and 94 m. above the stream: here one may cross to a third-order road on the E side of the gorge and follow it up stream (SE) 4 k. past the village of Allèves to the bridge of Banges, 20 k. from Aix (see Map 7), built near an ancient Roman bridge, where the second-order road from the col by Cuzy, having turned to SE, crosses to the right bank of the Chéran. The gorge cuts the Mtne. de Semnoz from the Mtne. de Banges (the NE extension of the Mt. de la Cluse); the unsymmetrical arch of the rocks

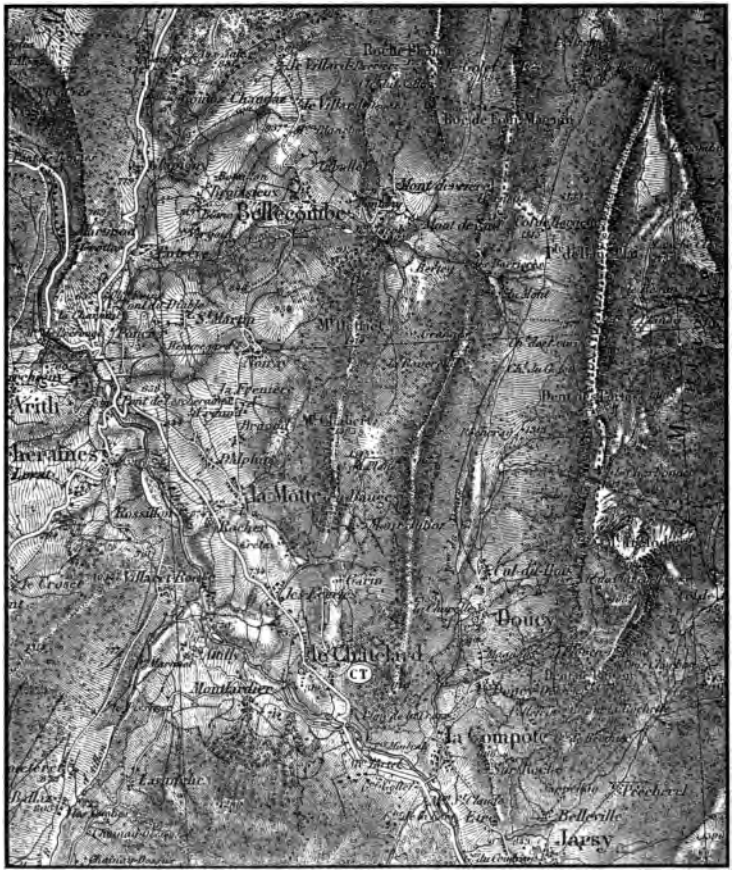
which form this marginal subalpine range is well seen, overthrust to the NW, in the walls of the gorge.

One k. S of the bridge of Banges, a cavern, la grotte de Banges, on the mountain side above the road (inn, rstt.) may be entered. A longitudinal valley, trending N and SW, then opens and is followed over easy cols by second-order roads in both directions: — N 22 k. over the Col de Leschaux, 904 m., to Annecy; SW 26 k. over the Col de Planpalais, 1180 m. to Chambéry; the latter road passes Lescheraines (inn) 0.7 k. after crossing the Chéran, and Les Dêserts (inn; see Exc. 3) 13 k. farther on: by taking this road the 90 k. circuit of this excursion may be reduced to about 60 k., of which the last 14 k. (Chambéry to Aix) may be made by train.

Le Chatelard, 757 m. (htls.), 9 k. from the bridge of Bange, 30 k. from Aix, lies on the NE side of the Chéran valley where two long parallel ridges extend N 15 k.; one of them forms the point by which Lake Annecy is constricted; S of the Chéran the two ridges soon unite in a single one which extends almost to the S-most point of the Bauges (see Exc. 11), where the Chambéry breach turns off from the Isère valley. The autumn fair held at Le Chatelard after the cattle are driven down from the mountain pastures is worth attending. The road crosses the Chéran 1 k. SE of Le Chatelard; 1.5 k. farther a rough mountain road comes from the head of Lake Annecy, 15 k. N, crossing over two high cols, 1659 m. and 1338 m., in a longitudinal valley, and passing the villages of Doucy and La Compôte before reaching the Chéran. At Ecole, 720 m. (inn), 4.5 k. SE of Le Chatelard, the road (see Map 8) turns S up an open longitudinal valley, and in 8 k. reaches the Col du Frêne, 956 m. (not to be confused with the col of same name on the other side of the Chambéry breach): here a superb view opens over the broad valley of the Isère and the mountains beyond. The road descends SE in zigzags 6 k. (by short-cut paths, direct distance, 2.5 k.) to St. Pierre d'Albigny (htls.), and 1.5 k. farther to ry. sta.: train SW and NW 24 k. to Chambéry, and N 14 k. to Aix.

If the night is spent at Le Chatelard or Ecole, the next day may be given to the ascent of the Trêlod, 2186 m. (Map 7), near the S end of the long Mtne. du Charbon, of canoe-like form. Follow the longitudinal valley, above mentioned, N past La Compôte and Doucy to Cul du Bois; here a guide is needed to show the path: the summit is reached in 4½ h. Descent by same path, 3 h.: descent by path E and S to Ecole is somewhat longer. From the Trélod a mountain path leads

N 4 k. to La Pointe du Banc-Plat, 1915 m. (spring near the top), on the W side of the canoe, whence an exceptionally fine view of Mt. Blanc is disclosed. The sharp N point of the canoe, 1573 m., may be reached by a path along the slope of the E side ridge, 6.5 k. from the Trélod.



MAP 7. THE VALLEY OF THE CHÉRAN NEAR LE CHATELARD

An even more attractive excursion may be made in a highland valley SE of Ecole (see Map 8), enclosed by the high ridges of a large " canoe " mountain on all sides, except where the Chéran head-

Map 8. The Headwaters of the Chéran and the Valley of the Isère

waters flow out to the NW through a deep notch. The canoe valley contains the forest of Bellevaux as well as many chalets on Alpine pastures: a guide is helpful to save time in selecting the desired path. A rough road ascends the valley of the Chéran SE from Ecole, 3 k., to the ruins of the monastery of Bellevaux, 907 m., in the Chéran notch, founded in the eleventh century, burned in 1825. There various paths branch into different parts of the highland valley. If time allows, visit the NE part of the valley and its high E rim; spend the night in a chalet with such fare as the peasants can provide. Otherwise take the S path from the ruined monastery past Plosta, 1412 m., and Les Arbets, 1552 m., to the Col d'Arclusaz, 1773 m., 4.7 k. from the monastery or 7.7 k. from Ecole: superb prospect over and across the valley of Isère. The Dent d'Arclusaz, 2046 m., 1 k. NNW from the col, or " La Chat," 1955 m., 1.5 k. NE, may be ascended from near Les Arbets. Return from the col via Ecole and the Col du Frêne, as above: or better, descend S from the Col d'Arclusaz by a steep zigzag path (before leaving Ecole, inquire about the condition of this path and the time needed for its descent to the railway; a guide is desirable for inexperienced climbers in the first part of the descent). Below the cliffs, turn SE and descend to Fréterive-le-Villard, 341 m., 2.1 k. direct distance from the col: thence S 3 k to Chamousset sta., 309 m. on the main railway line S of the Isère (unless a nearer station is found on the Albertville branch line that passes Fréterive on the N side of the Isère): train to Chambéry and Aix.

Exc. 11. *Maps 4 and 9. Chambéry and the southern ranges of the Bauges.* By train from Aix, S 14 k. to Chambéry, 270 m., pop. 23,000 (many htls.), formerly capital of the Duchy of Savoy.

The city is situated where the Leisse passes between the spurs that descend from the subalpine ranges of the Bauges on the N and of the Grande Chartreuse on the S. The breach which here separates the subalpine ranges is generally open floored, but it is locally narrowed by the two spurs: thus the location of the city is defined. Here the railway makes an easy low-grade crossing from the trough of Lake Bourget to the valley of the Isère and its branch, the Arc, on the way to Italy: the main range of the Alps which marks the boundary between France and Italy is pierced beneath the Col du Fréjus by the " tunnel des Alpes," 13 k. long, finished in 1870, the first subalpine tunnel (commonly but incorrectly known in the U. S. as the "Mt. Cenis tunnel," from a pass of that name which lies 22 k. NE, where the old stage road crosses the mountains).

Many objects of historic interest are to be seen in Chambéry: — The Cathedral dates from the fourteenth and fifteenth centuries; the castle, founded in 1232 but many times destroyed by fires, was restored in the nineteenth century; from one of its towers, a fine view is gained of the city and its surroundings; a museum containing remains of prehistoric lake dwellers, various Gallo-Roman antiquities, and a full collection of Savoy coins; the Jardin des Plantes and its museum, with geological, and botanical collections; in this museum is the office of an important

MAP 9. THE SOUTHERN RANGES OF THE BAUGES

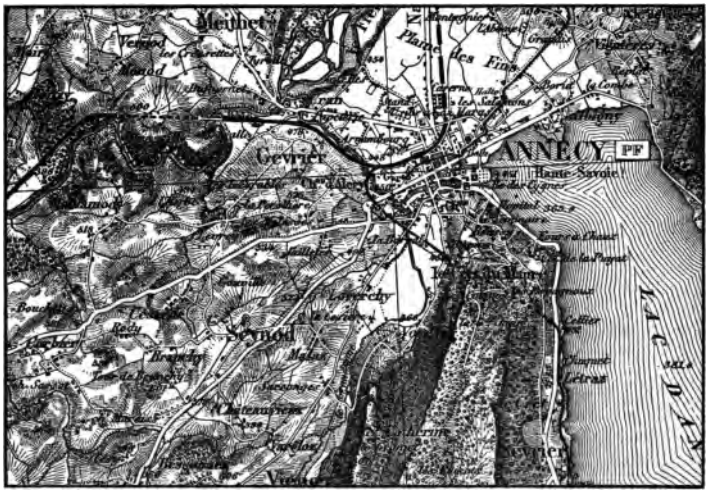
section of the French Alpine Club. Many industries flourish here. A fine view may be had from the church of Lemenc, on a spur, 320–350 m., 0.5 k. N of the railway.

One or two days may be well given to easy walks in the southern ranges of the Bauges, east of Chambéry, where a double " canoe " mountain — a smaller and higher canoe standing in a larger and lower one — forms the mountain salient between the valley of the Isère and the Chambéry breach. Cross the Leisse in the city, and follow the highway and second-order road ENE up the left (S) bank of the stream across the open breach, 300 m. alt., between the adjoining subalpine ranges: 4 k. from the city the deep chasm of the Leisse known as " le Bout du Monde " (the End of the World) is cut in a bench, 500 m. alt. Ascend the bench by a third-order road, S of the chasm, to Curienne, 8 k. from Chambéry, and continue SE 6 k. farther to La Thuile, 831 m. (inns), near a small lake in the depression between the round end of the lower canoe and the sharp end of the higher canoe. Many delightful rambles along valleys and over ridges may be made from this village as a center. The upper canoe, twice breached on its W side, has a knob, la Pointe de la Galoppaz, 1686 m., on its E side, 4 k. N of La Thuile; this is best ascended via Puisgros, NW 4 k. from La Thuile, and one of the W breaches. A second-order road from Chambéry via St. Jean d'Arvey (inn) and Thoiry (inn) enters the more northern of the two W breaches and turns N along the upper canoe valley past Aillon-le-Jeune to Aillon-le-Vieux, whence it is continued by a rough road to Le Chatelard, 14 k. (see Exc. 10). The lower canoe is breached 2 k. E of La Thuile, where a road zigzags down to Cruet in the Isère valley; but a better exit is made by ascending the round S end of the canoe to La Roche du Guet, 1210 m., 2 k. S of La Thuile, and descending thence by a zigzag path, S 1.5 k. to Montmélian sta. at ry. junction, 280 m. (htl.), 12 k. from Chambéry.

Exc. 12. *Annecy and Albertville:* a circuit of about 140 k. by rail or automobile around the subalpine ranges of the Bauges, with many enjoyable side-trips. Train 40 k., or road 30 k., from Aix N and E to Annecy, 450 m., pop. 15,600 (many htls.). From Annecy a branch railway and a highway turn SE 13 k. along the W border of Lake Annecy to Bout du Lac (Head of the Lake; rstt.). From Bout du Lac SE and E 9 k. over an open col, 508 m., near Faverges (htl.);

then by a winding valley E and S 19 k. to Albertville, 345 m., pop. 6270 (htls.), on the Arly near its confluence with the Isère. Down the Isère valley SW 35 k. to Montmélian (htl.); NW 13 k. to Chambéry, and N 14 k. to Aix.

A notable feature of the Isére in this stretch of its course is the artificial change from its former irregular, subdivided, tangled channels into a regulated, bent-rectilinear channel, enclosed by dikes. As a result, a large part of the valley floor, formerly abandoned to marshes, is now gained for profitable cultivation; also, although the restrained river now rises at time of floods to a greater height between its dikes than when it was free to spread to a great width, its velocity of flow is increased by its confinement to a shortened and therefore steepened course, and the discharge of its floods is thus accelerated.



MAP 10. THE NEIGHBORHOOD OF ANNECY

Recommended side excursions are as follows: (*a*) Leave train at Lovagny, 6 k. W of Annecy, for the remarkable chasm of the Fier (not to be confused with the gorge of the Fier, 12 k. farther W; see Exc. 9). The ancient castle of Montrotier, fourteenth century, is near-by to N: *continue to Annecy* by train or public car. (*b*) Map 10. Walk or drive *S from Annecy and ascend* ridge by good zigzag road about 3 k.; take

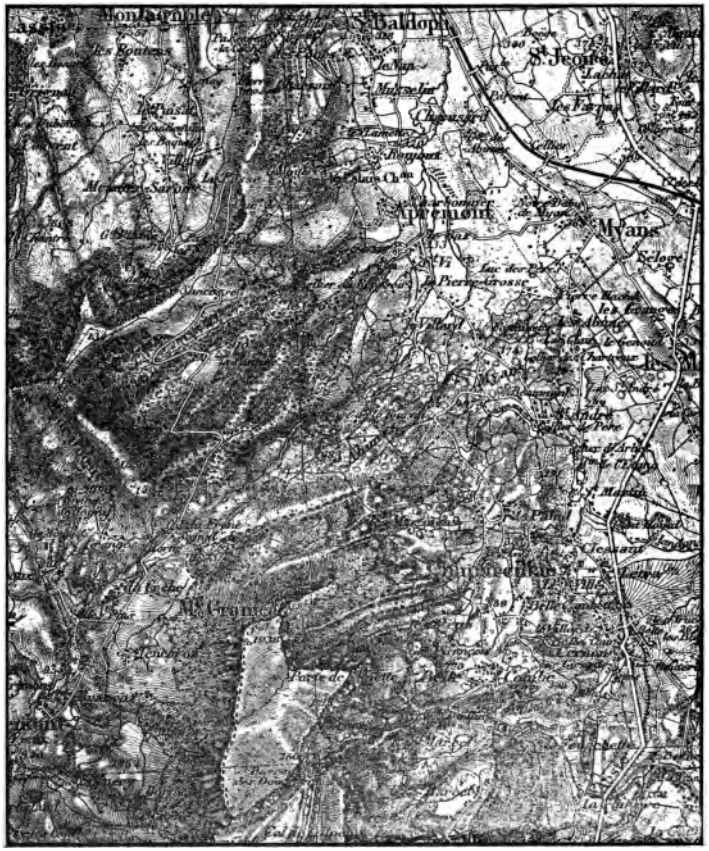
short path E to knob, 784 m.: fine view of lake and mountains beyond. (*c*) From Annecy ry. sta., tramway 1 k. to boat landing; steamboat (rstt.) on lake, alt. 446 m., to Bout du Lac in 1 h.; round trip 2½ h.; fine views of the adjoining mountains. (*d*) Leave steamboat at Talloires on E side of Lake Annecy for the Tournette, 2357 m.; ascent in 6 h.; inexperienced climbers should take a guide. The night may be passed on the way up at the Refuge de Blonay-Dufour, 1800 m. superb view of the Alps from the summit, which is the loftiest that is easily accessible from Aix.

(*e*) From Bout du Lac, a rough road leads S through a longitudinal valley with two cols, 1659 m. and 1338 m., 15 k. to La Compôte, and 3 k. farther to Ecole (see Exc. 11). (*f*) From Faverges, a rough road ascends the valley of the Tamié, past the Abbey of Tamié founded in the twelfth century, S 9 k. to the Col of Tamié; fine view SE across valley of the Isère to the mountains beyond: descend by zigzags S 5 k. to Frontenex, and 1 k. farther to ry. sta.; train SW to Chambéry and Aix. (*g*) Across the Arly E from Albertville is the ancient and picturesque town of Conflans, 430 m.; here ascent may be made E by a zigzag road to the "Blockhaus des Têtes," 1685 m.; fine view up the Isère valley to SE and down to SW. (*h*) The Grand Mont, 2698 m., SE 12 k. or 9–10 h. from Albertville, may be ascended nearly to the summit on mule-back: it is next to the highest mountain reached by the excursions here listed, and opens an extensive view in all directions.

Exc. 13. *Maps 4 and 11. The Col du Frène, Mt. Granier, and the Abîmes de Myans.* This is an excursion of varied interest in the northern ranges of the Grande Chartreuse. Train to Chambéry; cross the city to S and take a second-order road, ascending S to Les Charmettes, (a villa occupied by J. J. Rousseau, 1736–40) 1.8 k. from sta.; 2 k. farther S leave Montagnole, 557 m., on the W; the road rises S toward the cliffs of Mt. de Jogny, beneath which, 7 k. from Chambéry, 706 m., it loops NE 1.2 k. then S 1 k. to a tunnel, 776 m., 9.2 k. from Chambéry, under the Col de la Fosse, a notch in a long cliff-sided spur that descends NE from Mt. de Jogny: before entering the tunnel, a fine view is had N along the trough of Lake Bourget; after leaving the tunnel, an extensive view is opened NE across the Chambéry breach to the subalpine ranges of the Bauges, and SE across valley of the Isère to the high mountains beyond. Mt. de Jogny, first summit, 1497 m. farther S, 1574 m. — superb views — may be reached by a path which leaves the road 0.3 k. S of tunnel and ascends 2.7 k. along crest of spur.

Beyond the tunnel, the road zigzags (rstt. at apex of first pronounced outward angle; here a path descends NE 3.4 k. to Apremont) in a well-laid S-ward course 5.5 k. along a forested slope,

varied by spurs and ravines, to the Col du Frêne (not to be confused with col of same name in the Bauges, Exc. 11), 1164 m., 14.7 k. or



MAP 11. MT. GRANIER AND THE ABÎMES DE MYANS

4 h. from Chambéry. The cliffs of Mt. Granier rise to SE: they are *the source of a landslide* about 6 k. in length, which occurred in 1248

and caused the death of several thousand villagers whose homes were in its path; the uneven surface of the slide has many hollows holding small ponds, known as the Abîmes de Myans, from a village at the base of the slope. The return to Chambéry from the col may be made by the road of ascent in about 3 h.

The descent to the railway may be shortened by turning down a path NE from near the col, or from either the first or the second sharp outward angle of the road N of the col: if the path near the col is taken, it descends on the landslide, and 4 k. from the col joins a road that runs E to St. André, whence a lane leads E 1 k. to a main highway: this runs N past Les Marches 2.5 k. to ry. sta.; train, 9 k. to Chambéry, 14 k. more to Aix. If a descending path is taken from either angle of the road N of the col du Frène, follow it nearly to Apremont, 5 k. from col; then take road E past Myans 3.5 k. to ry. sta., as above. From the Col du Frène to this sta , about 2 h.

For the ascent of Mt. Granier, an extra day is needed. Follow road — see Map 11 — SW 4 k. from the Col du Frène down a highland valley between two of the subalpine ranges of the Grande Chartreuse to Entremont-le-Vieux, 840 m. (inn), where a guide for the Granier should be engaged and the night passed. (The road continues down the valley 5 k. to St. Pierre d'Entremont, 640 m. (htls.), whence a path leads SW over a col, 8 k., to the monastery of the Grande Chartreuse, of less interest since the expulsion of the monks in 1903; thence a road leads 8 k. to St. Laurent at W base of range, and NE 25 k. to Chambéry.) The path from Entremont-le-Vieux ascends the valley side E 2.8 k., then makes a steep climb up " chimneys " in cliffs to the Col de Balme-Colon, 1850 m., a notch in the sharp ridge crest: descend a little and turn N along E slope, part way on bare, ragged limestone (" lapiaz "), 1.3 k. to summit, 1938 m., about 4 h. from Entremont. Exceptionally fine view NE to the Bauges, E and S over a great length of the broad valley of Graisivaudan followed by the Isère, beyond which rise the chain of Belladonne and the snowy summits of the Grandes Rousses: the main range of the Alps, including Mt. Blanc, is seen in distance. Return via Col de Blame-Colon and descend to Col du Frène in about 3 h.; thence by road, to Chambéry, about 3 h. more.

Exc. 14. *Map 12. Allevard and the Seven Lakes.* This two-day excursion includes an ascent of one of the highest summits of the

chain of Belladonne, SE of the open valley of the Isère (the Graisivaudan). Train from Aix S via Chambéry 35 k. to Pontcherra sta., 256 m. (rstt.), in the Graisivaudan E of the Isère: tramway, 1 h.

MAP 12. THE ROCHER-BLANC AND THE SEVEN LAKES

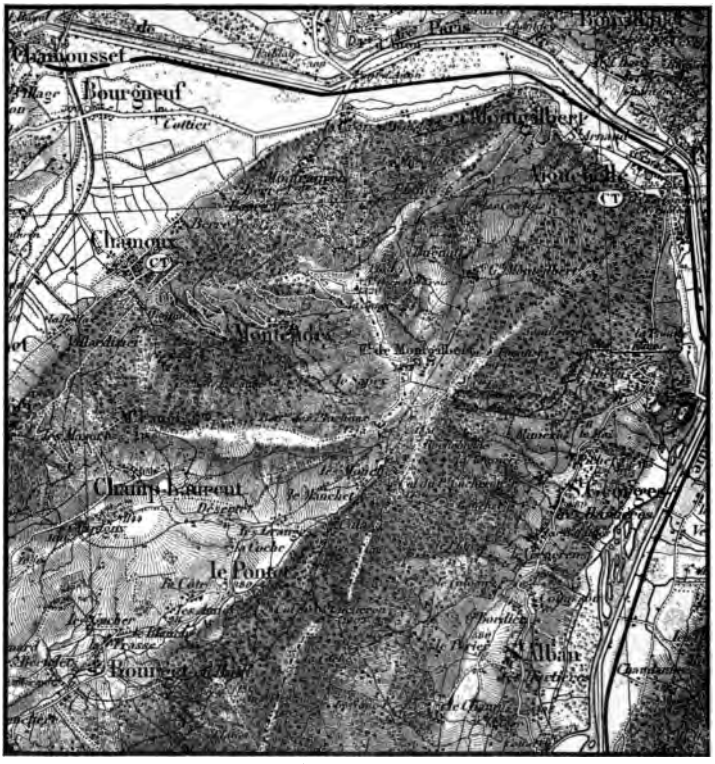
E, past the near-by village of Pontcherra (inn; ½ h. to S is the *Château Bayard*, the birthplace in 1476 of the perfect knight, "*sans peur et sans reproche*") and up the lower gorge of the Bréda

8 k. to Détrier, 350 m.; then S 7 k. along the open valley of the Bréda to Allevard, 439 m. (htls.), noted for its hot springs and as a center for mountain excursions. The finest of these is S to the head of the Bréda valley, where the Seven Lakes (" les Sept Laux " — *Laux* is Savoyard patois for *Lacs* —) lie in rocky basins surrounded on E, S, and W by lofty and rugged Alpine peaks of crystalline schists, very different in form and appearance from the subalpine limestone ridges with their long lines of cliffs in the Bauges and the Grande Chartreuse.

A guide is not needed to the lakes, but is essential if the ascent is extended to the Rocher-Blanc. A warm cloak may be wanted on the mountain top. From Allevard S up the valley on mountain road (by carriage, if desired) 12 k., 3½ h. to Le Curtillard (inn), where the night should be spent. A path continues the steeper ascent to the valley head: 5 k. S of Le Curtillard the first of the lakes is reached, surrounded by wild and desolate mountains; 3 k. farther S, or 5½ h. from Le Curtillard is a chalet-hotel, 2187 m. (open in summer season) near the Col des Sept Laux, 2200 m.: fine view into valley on the S. The Rocher-Blanc, 2930 m., lies 3 k. NE from the col: it may be reached in 2½ or 3 h.; fine view of snow fields and small " hanging " glaciers on the Grandes Rousses, over 3000 m., 8 to 15 k. to SE and S. Return to col, 1½ h.; thence to Allevard about 5 h.

Many other excursions may be enjoyed from Allevard. An interesting NE detour may be made when returning to Aix: — Take tramway to Détrier; change to a branch line, NE 2.5 k. over an open col to La Rochette, 345 m. (inn) at a sharp bend of the Geton; here turn E into the upper valley of this stream, and follow it (see map 13) NE past Bourget-en-Huile, 819 m., 8 k. and Le Pontet, 880 m., 10 k., to the valley head, 13.5 k., where the Fort of Montgilbert, 1374 m., and several neighboring ridge-crest redoubts (do not sketch or photograph near the fortifications) dominate the railway from Italy in the valley of the Arc to E. Iron mines are on the SE slope of the ridge. Turn NW 1.5 k. along the ridge and descend W 3 k. by the short-cut paths of a zigzag road that ascends to the Fort — an excellent example of mountain road-making — past Montendry to Chamoux at the ridge base in the lower valley of the Geton: then N 3 k. to Chamousset, 309 m. (inn); train to Chambéry, 28 k., and Aix, 14 k.

This district is of historical interest, as it is plausibly identified as a part of Hannibal's route over the Alps, 218 B. C., where he had an encounter with the Allobroges: he is supposed to have ascended the valley



MAP 13. THE DISTRICT OF MONTGILBERT

of the Geton, in making a short cut from the Isère to the Arc, and to have fought with the natives in one of the notches of the ridge crest S of Montgilbert.

AUTOMOBILE EXCURSIONS

THE beauty of the scenery and the excellence of the highways in *southeastern France* combine to make excursions by automobile a *most delightful entertainment*. The excursions here briefly de-

scribed lead to districts of the most varied interest. On the west the genial valley of the Rhone has been a thoroughfare for ages past; there one sees historic towns that have been continuously occupied since their monuments of ancient Roman colonization, now in ruins, were built. To the east rise the forbidding Alps, where out-of-the-way villages have long lain in seclusion; there one sees new activities around recently installed industrial plants, in which intense electric currents are generated by plunging torrents from the high snow-fields of the mountains. The scenery is everywhere attractive. Figures for distances and populations are approximate. All the towns and cities here named have inns or hotels.

Exc. 15. *Northwest of Aix. Map A, NW.* The Jura mountains and the valley of the Saône above Lyons. From Aix N 55 k. to Bellegarde, 370 m., pop. 4000: fine views to E from the road on the slope of the Mtne. du Grand Colombier between Culoz and Bellegarde. Near the latter point, the gorges of the Rhone (see below) and of the Valserine deserve visits.

At Bellegarde an additional Jura range, E of the Grand Colombier, rises in the Grand Crédo and continues far NE. The Rhone has cut a gorge, known as the Ecluse, 5 k. E of Bellegarde, between the Grand Crédo and its lower SE prolongation, the Mtne. de Vuache. Below the gorge the river makes a bend around the S end of the larger mountain, and then a sharper N bend before taking its course along the flank of the Grand Colombier: the famous Perte du Rhone, where the river flows in a narrow chasm, is in the N bend near Bellegarde. The main railway from Geneva to Lyons passes by a tunnel, 3.9 k. long, through the S end of the Grand Crédo, while the highway and the river pass around it; all three pass through the Ecluse, where the highway and railway both branch so as to continue E on both sides of the river. The gorge is crowned on the N by the frontier Fort de l'Ecluse, 423 m., for the acute salient of Swiss territory, which follows the Rhone for 17 k. below Geneva between the E and NE extensions of France, here lies only 5 k. to the E. This point is well worth a visit by rail from Aix. The ascent of the Grand Crédo, 1606 m., from Bellegarde station (6 h. up and back) is repaid by a superb panorama of the Alps and of Lake Geneva to the E and a broad view over the Jura ranges to the Central Highlands of France beyond Lyons on the W.

From Bellegarde NW and W through cross valleys of the Jura ranges 22 k. to Nantua, 480 m., pop. 3000, between Lake Silan, barred by a landslide, and Lake Nantua, held by a terminal moraine that was deposited during the final retreat of the Rhone glacier


MAPA–NW
1:800,000
AIX-LES BAINS


MAP A–NE
1:800,000


MAP A – SW
1:800 000


MAPA-SE
1:800.000

which overspread all but the highest ridges of this region during the glacial period.

The route from Bellegarde to Nantua may be lengthened to advantage by turning E at Bellegarde past the Fort de l'Ecluse, 13 k. to Collonges; then N along the base of the Jura mountains 26 k. to Gex, where a zigzag NW ascent (about 7 k.) of the first Jura range begins, adjoining a huge gulf, deeply excavated in the arch of the range and revealing its inner structure; during the ascent superb views are opened to the SE across the Swiss foreland and Lake Geneva to the Alps. From the summit, 1323 m., N by longitudinal and transverse valleys 20 k. to Morez; then SW either over high ground E of the Ain, or along the W side of the longitudinal Ain valley 25 k. to St. Claude on the Ain; follow the winding, obliquely transverse valley of this river SW 23 k. to village of Dorlan, where the road turns S through a longitudinal valley 20 k. to W end of Lake Nantua: after leaving Morez, the road is of second order.

From Nantua W 40 k. over lower marginal ridges of the Jura mountains to Bourg, 240 m., pop. 20,500, in the open country of the Saône basin. Continue W 31 k. to Macon, pop. 19,800, on the Saône, and turn S between the Saône and the E base of the Central Highlands, 67 k. past Villefranche to Lyons, 165 m. at river, pop. 523,800 (exceeded only by Paris and Bordeaux): or take the direct road from Bourg SW 60 k. to Lyons across the Pays de Dombes, an upland of drift formed by the NW-most extension of the ancient glacier of the Rhone, dotted with many fish ponds, Fine views over Lyons from the hills on N and W. Return from Lyons, ESE, via La Verpillière, 27 k., La Tour du Pin, 26 k., Le Pont de Beau-Voisin, 18 k., Les Echelles, 13 k.; then NE 20 k. to Chambéry and N 14 k. to Aix, 110 k. from Lyons. Total distance, via Macon, 333 k.; including detour via Gex, 435 k.

Exc. 16. *Southwest of Aix. Map A, SW (in part).* The valley of the Rhone at Valence and Grenoble on the Isère. From Aix S 14 k. to Chambéry, and SW to Les Echelles, 22 k. and Voiron, 20 k. (this 20 k. stretch is by a second-order road); thence SW down the right side of the valley of the Isère via Tullins, 13 k., St. Marcelin, 23 k., and Romans 26 k.; here cross the Isère and continue 18 k. farther to Valence, 124 m., pop. 28,700, on the Rhone, 136 k. from Aix.

A recommended short detour on second-order roads crosses the Isère at La Sône, 7 k. beyond St. Marcelin and turns SE 10 k. to the picturesque town of Pont-en-Royans, 300 m., pop. 1100, between two deep gulfs on the W side of the highland of the Vercors, the S-most member of

the subalpine limestone ranges; return to La Sône and continue on main road; or remain on SE side of the Isère valley and go W by a second-order road via St. Nazaire 25 k. to Le Bourg-du-Péage, where the main road crosses the river from Romans.

This route to Valence may be advantageously lengthened by turning NW at the village of St. Jacques, 5 k. beyond Voirons, ascending over morainic hills, 6 k. to Rives, crossing the plain of Bièvre to La Frette, 13 k. and continuing over a hilly upland to Champier, 9 k.; then W by second-order road via Chatonnay and St. Jean-de-Bournay, 36 k. to Vienne on the Rhone, 160 m., pop. 24,700. At Vienne, turn S through beautiful scenery and follow either side of the Rhone by first-order roads — the road on the right (W) side is to be preferred, though a little longer than that on the left — via Tournon, about 50 k. to Valence.

Instead of continuing the main excursion, as below, return may be made NE up the Isère, taking in Pont-en-Royans (see above) on the way, 75 k. to the village of St. Jacques, where the detour began; there turn SE through the breach between the subalpine ranges of the Grande Chartreuse and the Vercors to Grenoble, 22 k.; then NE and N up the Isère valley 56 k. to Chambéry, and N 14 k. to Aix.

From Valence, S 14 k. to a fork in the road; here turn SE and ascend the valley of the Drôme via Allex and Crest, 12 k., then E and NE 35 k. farther to Die, 401 m., in the mountainous margin of the Alps of Dauphiny, with the great terminal scarp of the Vercors rising boldly in the north. Continue SE up the Drôme 35 k., cross over the Col de Cabre, 1180 m., and descend ESE 12 k. to Aspres-sur-Buech, 800 m. Turn N 26 k. to the Col de la Croix Haute, 1176 m., and continue N by a superb road that contours many spurs and ravines on the E slope of a notched ridge, via Monestier-de-Clermont 45 k. to Vif, and 10 k. farther down the valley of the Drac to Grenoble, 215 m., pop. 77,500. This university city is beautifully situated where the Isère enters its breach through the subalpine ranges; a fine view over the city is gained from the ridge on the N. Then NE and N 56 k. beneath the cliffs of the Grande Chartreuse ranges by the main highway on the W side of the section of the Isère valley known as the Graisivaudan and into the Chambéry breach, and N. 14 k. farther to Aix; or along the E side of the Graisivaudan by a second-order road at the base of the Belladonne chain, and into the Chambéry breach, 60 k., and 14 k. more to Aix.

Exc. 17. *Southeast of Aix. Map A, SW and SE.* Gap, Briançon and the high mountains of the Pelvoux group. From Aix, S past Chambéry and through the Graisivaudan 70 k. to Grenoble; S 7 k. to a fork of roads at Pont-de-Claix; turn SE 8 k. to Vizille, then S 21 k. to La Mure-d'Isère, 1213 m.; here ascend the valley of the Drac SE past Corps to St. Bonnet 40 k., and run S 9 k. over the Col Bayard, 1246 m., to Gap, 876 m. Turn E 20 k. via Chorges to the valley of the Durance, which is then ascended NE past Embrun and N past L'Argentière 63 k. to Briançon, 1326 m. Turn NW 26 k. up the valley of the Guisane, past Le Monêtier-de-Briançon to the Col du Lautaret, 2057 m.; here the snowy Pelvoux Alps rise boldly to the S; the sharp summit of La Meije, 3987 m., is directly opposite the village of La Grave, 1386 m., 10 k. W of the Col in the valley of the Romanche. This valley is followed W 24 k. to Le Bourg-d'Oisans, then by a winding W course 32 k. to Vizille, whence the further return retraces the outward route via Grenoble and Chambéry to Aix.

Exc. 18. *Southeast of Aix into Italy. Map A, SE.* This excursion goes for 177 k. via Chambéry and Grenoble as far as Briançon, 1326 m., reversing the route given for the latter part of the preceding excursion. From Briançon ascend NE 10 k. to the Italian frontier on the Col du Mt. Genèvre, 1854 m., and descend NE past Cézanne and Oulx, part way on second-order roads, 40 k. to Susa, 495 m., in the valley of the Dora Riparia, on the main line of the railway that has passed under the mountain crest by the "tunnel des Alpes." Turn NW and ascend rapidly by many zigzags 20 k. to the Lake of Mt. Cenis, 1913 m., and 3 k. farther to the frontier on the Col of Mt. Cenis, 2091 m.; the passage over the col is controlled by several Italian forts on the slopes near the lake. Descend N 10 k. by zigzags to Lanslebourg, 1390 m., in the valley of the Arc; here run SW 23 k. down the valley to Modane, 1074 m., where the railway makes a loop backwards preparatory to turning S into its 13 k. tunnel. Continue down the Arc, W 29 k. to St. Jean-de-Maurienne, 573 m., N 32 k. to Aiguebelle, and W 10 k., to the junction of the Arc with the Isère; then SW along the Isère 14 k. to Montmélian, NW 13 k. to Chambéry, and N 14 k. to Aix.

Exc. 19. *Southeast of Aix. Map A, SW and NE.* The mountains at the headwaters of the Isère and the Arc. This Alpine excur-

sion is best made in two parties. Each party leaves its car at the end of the highway in the valley that it ascends, walks over the mountain pass between the valley heads, and returns in the car that brought the other party. One party follows, for 135 k. but in reversed order, the road described in the last part of the preceding excursion, finally ascending the valley of the Arc to Lanslebourg (htl.), 1390 m., 135 k. from Aix; beyond this point the road is poor, and it may be necessary to walk part or all of the remaining distance, NE 17 k., to Bonneval, 1835 m. (summer inn), where the night is spent.

The next morning make an early start; walk (guide unnecessary) N 6 k. up to the Col du Mt. Iseran, 2769 m. in the midst of wild Alpine scenery (the other party should be met hereabouts) and descend NW 5 k. to the village of Val d'Isère, 1849 m. (htl.); time required about 5 h.; continue on foot NW down the Isère by rough road part or all the 33 k. to Bourg-St.-Maurice (htls.), before meeting the car left there the day before by the second party; thence down the Isère SW 24 k. to Moutiers (htls.), NW 23 k. to Albertville, SW 21 k. to Chamousset, where the outward route is joined, with 44 k. remaining of the total 112 k. to be made to Aix.

The second party goes by Albertville and Moutiers 112 k. to Bourg-St.-Maurice (htls.) and as far SE as possible along the 33 k. stretch of poor road, of which the remainder must be made on foot to Val d'Isère (htl.) for the night. Early the next day, the Col de Mt. Iseran is crossed, and descent is made S to Bonneval and SW down the valley of the Arc towards or to Lanslebourg (htl.) where the return trip in the first party's car begins.

Exc. 20. *Northeast of Aix. Map A, NE.* Chamonix and Geneva.[1] From Aix via Chambéry to Albertville, 65 k., as in the preceding excursion; then N and NE up the valley of the Arly 33 k. to a col at its head, 1121 m., just beyond the village of Mégève; descend N 12 k. to Sallanches, 550 m., in the valley of the Arve; E up the valley (fine view of Mt. Blanc) 24 k. to Chamonix, 1041 m., famous center for excursions in the Mt. Blanc district. Return down the valley of the Arve, past Sallanches, 42 k. to Cluses; then either by Bonneville or St. Jeoire, past Annemasse (the Swiss frontier[1] is crossed 2 k. farther on) 40 k. to Geneva, pop. 58,000, or 106,000 including suburbs, beautifully situated on both sides of the

[1] Permission to cross the frontier into Switzerland may not be granted.

Rhone where it flows out of Lake Geneva. Turn S, via St. Julien 40 k. to Annecy, and continue 30 k. farther to Aix.

This excursion may be shortened by going from Aix via Annecy and Bonneville, 65 k. to Sallanches (instead of 110 k. via Albertville), and then to Chamonix, 24 k. While at Chamonix, if the weather is fine and time allows, walk up the NW side slope of the valley (no guide needed; afternoon hours are best) past Bel-Achat to Le Brévent, 2525 m., 4¼ h. (inn), and spend the night there; unsurpassed view of the chain of Mt. Blanc, across the valley of Chamonix to the S; sunset and sunrise effects are superb; descent 2½ h. From Annemasse, ascent may be made S by electric railway to Treize-Arbres (Treize (13), is a corruption of the local patois, treis, for 3) on Mt. Salève, 1184 m. (rstt.): fine view of Alps, Lake Geneva and the Jura; round trip 3–4 h.

EXCURSIONS BY RAILWAY

Besides the several excursions described above (Exc. 6, 7, 8, 9, etc.) in which part of the distance from Aix is made by railway, many others of greater length might be indicated. A few of the most interesting are as follows:

Exc. 21. One day: N via Culoz to Bellegarde; ascent of the Grand Crédo on foot (see Exc. 15).

Exc. 22. Two or three days: W via Chambéry or Grenoble to various points in the valley of the Rhone. The most picturesque parts of the valley for walking are (1) from Givors past Vienne to Condrieu; this stretch is reached via Chambéry and Lyons; return via St. Rambert and Grenoble: (2) between St. Vallier and Tournon; reached via Grenoble and St. Rambert, return via Valence and Grenoble.

Exc. 23. One day: S via Chambéry to Grenoble.

Exc. 24. One or two days: S via Grenoble and Clelles to Lalley; walk NE and N via Mens 25 k. to La Mure-d'Isère, and return by a picturesque narrow-gage railway past the gorge of the Drac to Grenoble (see Exc. 16).

Exc. 25. Two days: S via Grenoble to Pont-de-Claix: walk SW via the Col de l'Arc, fine view, and W over the subalpine highland of the Vercors via Villard (spend the night here) and Pont-en-Royans, about 40 k. to La Sône; return by train up the Isère valley to Grenoble, etc.

Exc. 26. One day: SE via Chambéry to La Chambre or St. Jean-de-Maurienne in the valley of the Arc.

Exc. 27. Two days: SE via Chambéry past La Chambre to Modane and through the " tunnel des Alpes " into Italy as far as Susa in the deep *valley of the Dora Riparia* (see Exc. 18) or Turin on the broad piedmont *plain of the Po.*

Exc. 28. Two or three days:[1] NE via Annecy and Bonneville to Chamonix (see Exc. 20); return via Geneva (Switzerland) and Culoz; or continue by mountain railway from Chamonix NE over the Tête Noire pass to Martigny on the upper Rhone (Swiss territory); return via the lake and the city of Geneva.

Exc. 29. Two days:[1] N via Culoz to Geneva (Switzerland), and by steamboat on Lake Geneva to Vevay or Montreux on the N or Swiss side of the lake near its E end, for the night. Return by steamboat to Evian-les-Bains on the S or French side of the lake, and by train via Annemasse and Annecy to Aix.

ORIGIN OF ALPINE TOPOGRAPHY

The Enjoyment of Mountain Scenery. The more closely one enters into sympathy with nature during mountain excursions, the greater are the enjoyments that they yield. Sympathy may begin at first acquaintance; it grows and deepens as understanding advances it into intimacy. Mountains are huge physiographic ruins, literally delapidated by the ravages of time. The impression that they make on the observer is greatly strengthened when he recognizes them to be only the present-day remains of vast structural designs built up in the remote past by internal forces powerful enough to crush and upheave the heavy crust of the earth, and slowly carved by external forces patient enough to wear away the solidest rocks — forces so unendingly persistent that they will eventually reduce the highest mountains to lowlands; for mountains are, as the earth regards them, ephemeral forms. The fullest pleasure, the most complete recreation comes from mountain excursions only when the view of ridges and valleys as seen by external eyesight is supplemented by thoughtful insight, to which it is hoped that this chapter may contribute.

Slow Development of Mountains. The Alps, like mountains in general, were formerly looked upon as the result of violent upheavals or " convulsions of nature." Careful observation and reasoning reflection have compelled a very different belief. The Alps, like other mountains, are now known to be the diminishing remains of a much greater volume of the earth's crust which was slowly crushed and upheaved in broad and massive forms, and which during and since its slow upheaval has been still more slowly carved into its present mountainous form. The carving is still in progress.

Deposition, Deformation, and Denudation. Three unlike processes deserve recognition in the long process of mountain making in the Alps; these processes should not be regarded as theoretical abstrac-

[1] Permission to enter Swiss territory may not be granted.

tions, but as realities, the consequences of which are visible on every hand. First, the deliberate deposition of a heavy series of horizontally stratified rock-formations — each formation of vast extent compared to its thickness — upon a foundation of more ancient crystalline rocks. Most members of the stratified series contain fossils of marine organisms, and must therefore have been slowly deposited in successive layers on an ancient sea bottom; they are well exposed in the subalpine ranges. The crystalline foundation rocks may be seen in the chain of Belladonne and the higher ranges farther east.

Second, the gradual deformation of the compound mass by irresistible forces, whereby both the massive foundation rocks and covering strata were slowly crushed and folded, overthrust and upheaved, in a most complicated manner. Innumerable earthquakes were probably caused by the deforming forces, but the intermediate intervals of rest must have been much longer than the moments of disturbance. As the axes of the folds hereabouts trend N–S or NE–SW, the crushing forces must have acted in a transverse direction; and as many of the folds are overthrust to the W or NW, the push of the crushing forces must have been exerted from the E or SE.

Third, the very slow denudation of the crushed and upheaved mass by destructive exterior forces, chiefly weather, water, and ice, whereby the broad elementary forms of deformation and upheaval have been reduced to elaborately carved mountains and ridges, between deeply incised valleys. A good beginning has thus been made toward the complete obliteration which must in time overtake the Alps, as it has already overtaken many more ancient mountain systems.

The Heavy Series of Stratified Rocks. The great thickness of the strata that were accumulated during the period of deposition is manifest on every excursion: the marine origin of the strata is readily proved by the fossils which many beds contain in abundance.

Two localities may be specified for observation in this connection: First, a section extending northeast 3.7 k. from Chazey, half-way between Virieu-le-Grand and Belley (Exc. 6), crosses 13 successive formations (members of the Lias, Jurassic, and Cretaceous divisions of *medieval geological* time), all dipping northeast, measuring roughly *1000 m. in total thickness,* and including many fossiliferous layers; the

oldest members lie at the base of the series in the SW, the younger members follow to the NE. Second, a section across the two "canoe" mountains that form the southern angle of the Bauges (Exc. 11) traverses 11 formations (from the middle Jurassic through the Cretaceous to the middle Tertiary divisions of medieval and later geological time); here the undermost or oldest formation lies at the eastern base of the larger and lower canoe, while the uppermost and youngest lies in the trough of the higher and smaller canoe; the thickness of the strata here exposed measures over 1000 m. Underlying strata of great thickness are not visible here. All these strata must have been deposited in essentially horizontal position before they were tilted and folded; their deliberate deposition to the great thickness that they possess must have occupied millions of years. Examine the beds in some good outcrop; imagine them in their original horizontal attitude, and try to conceive the time required for their gradual accumulation, layer by layer!

The recognition of corresponding strata in different mountains is greatly aided by the topographic dominance of a strong limestone (Urgonien) near the top of the stratified series. Nearly all the stronger ridges are formed of this one formation; thus the steep strata of the ridge sides that border Lake Bourget (Exc. 2, 4, 5, 9), the arch of the Grand Colombier (Exc. 8), the slanting layers in the cliffs of the Dent du Nivolet (Exc. 3), the great arch of strata in the broad mountain of the Semnoz where the Chéran flows out of the Bauges, the canoes of the Mtne. du Charbon and of the Chéran headwaters (Exc. 10), the upper canoe in the southern angle of the Bauges (Exc. 11), and the lofty rock slab of the Granier (Exc. 12) are all parts of one vast extension of heavy limestone layers, originally horizontal and continuous, now bent and denuded. If allowance be made for the folded structures, as shown in Figs. 1 and 2 it is comparatively easy to distinguish the overlying and the underlying formations by their relation to this dominant member. The danger of error is chiefly where the strata are overturned, as in the slope beneath the cliffs of the Revard and the Dent du Nivolet, and locally on the east side of the lower canoe in the southern Bauges.

The Upfolds of the Jura Ranges. The deformation of the strata is recognized on every hand. The ridges of the Jura system are usually upfolds or arches, as shown in Fig. 1. The amount and the form of their upfolding is seen to vary when a ridge is followed along its length.

Thus the arch of Mt. de Corsuet (Exc. 2) begins in a rather symmetrical form as it rises north of Aix; it becomes unsymmetrical as it continues with the names of Mtnes. de Cessens (Exc. 2) and du Gros Foug (Exc. 9), and becomes almost symmetrical again as it falls off in the Mtne. des Princes, about 30 k. N of its beginning; here its internal

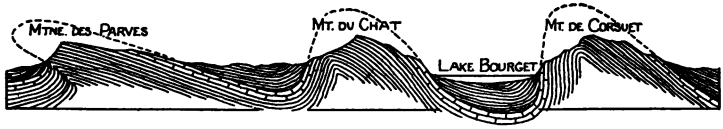


FIG. 1. SECTION OF JURA ARCHES, AFTER HOLLANDE

structure is well disclosed in the transverse gorge of the Fier (Exc. 9). Again, the fairly symmetrical fold of Mt. du Chat (Exc. 4) is prolonged S-ward unsymmetrically in the Mtne. de l'Epine (Exc. 7), which is separated from the subalpine ranges of the Grande Chartreuse only by the narrow trough valley of Couz; the fold is prolonged N-ward still more unsymmetrically through Mt. de la Charvaz (Exc. 5) to its end in Mt. Landard, beyond which the Rhone makes its crossing before the upfold rises again for a long northward continuation in the Mtne. du Grand Colombier (Exc. 8). The unsymmetrical folding, with steeper dips on the west, is sometimes carried to the extreme of overthrusting, as in Mt. Landard, above mentioned, and in the Mtne. de Parves (Exc. 6); in these examples the western limb of the fold is not seen.

The Complicated Folds of the Alps. The folding in the subalpine ranges is closer and more complicated than in the Jura, as appears

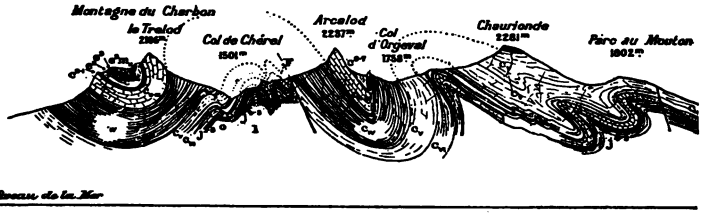


FIG. 2. SECTION OF THE BAUGES, BY LUGEON

in the section of the Bauges, Fig. 2, in which several successive folds of the stratified rocks are represented. The crushing of the *lofty central ranges of the* Alps is carried to an extreme of pinching,

twisting and overthrusting, so that the downfolds are closed into narrow, wedge-like structures, as shown in Fig. 3.

In the central ranges the crystalline foundation rocks are often seen to be involved with the lower members of the covering strata in the tremendous deformation that the region has suffered. Here the originally stratified rocks have frequently been changed — "metamorphosed" — into crystalline schists, as a result of the tremendous pressure to which they have been subjected. Many years of the most

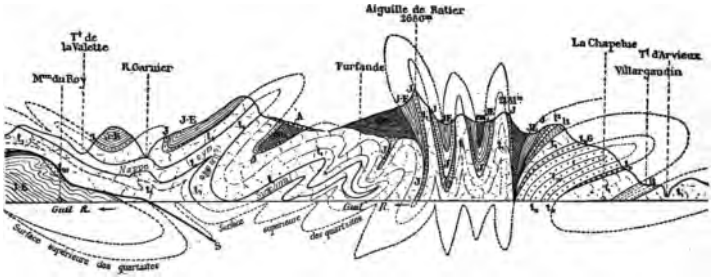


FIG. 3. SECTION OF THE HIGH ALPS, BY KILIAN

patient and painstaking investigation by the ablest geologists have been necessary to decipher the structural complications of the central ranges; but to produce these complications the forces of deformation must have worked intensely and persistently for vast periods of geological time, in which years would count only as moments. The strength of the forces is far beyond our comprehension.

Slow Progress of Denudation. The partial denudation of the upheaved and folded structures is as manifest as their deformation. The strata are seen to outcrop edgewise on the crests and slopes of the ridges; their downward prolongation is still preserved underground, as shown by the inferred structural lines in the sections of Figs. 1, 2, and 3; but their upward prolongation, imperfectly shown by dotted lines in the sections, is lost, and the loss has been occasioned by the long-enduring action of destructive forces, such as are still engaged in the slow operation of mountain carving.

It is not easy to conceive that the gradual disintegration of rocks by weathering and the slow removal of the weathered débris by down-slope creeping and washing can have reduced the huge upfolds of the initial

Alpine upheavals to the diminished, though still great dimensions of the existing ranges; and it is perhaps still less easy to conceive that the continuation of this slow destructive work at its present rate will in time reduce the existing ranges to lowlands; but no true understanding of the elaborately carved forms of mountains can be gained until they are perceived to be in slow transition from the broad initial forms of disorderly upheaval to the ultimate lowland form of completed degradation. Stand on an upfolded and partly denuded ridge and strive to realize the vast measures of time that the making and unmaking of its strata represent.

The Troughs between the Jura Arches. The amount of material thus far removed from the upheaved masses varies greatly in different parts of the mountain region. The smallest measure of removal is in the deep troughs between the Jura arches; there the youngest members (Miocene) of the stratified series, in spite of being but moderately resistant, are in large measure preserved, because they lie so low in the troughs that streams cannot successfully attack them.

The young strata may be seen, more or less crumpled and denuded, in the low hills occupying the broad trough or depression between the Mt. du Chat and the S prolongation of the Mtne. de Parves (Exc. 6), or in the depression which broadens northeastward between the Mt. de Corsuet and the Mt. de la Cluse. Nevertheless, a considerable measure of erosion has taken place even in these areas, especially in the excavation of such a trough basin as that in which Lake Bourget lies, Fig. 1, with a depth of 145 m., as will be further explained below.

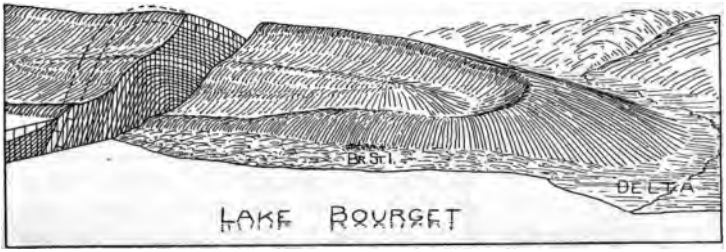


FIG. 4. THE UNROOFED ARCH OF MT. DE CORSUET

The Worn Crests of the Jura Arches. A greater amount of erosion has taken place on the Jura arches, because by reason of the height

to which they were upfolded, the débris loosened by the weathering of their crests has been rapidly washed down their slopes. Here not only have the weak uppermost strata been completely stript away, but some of the resistant underlying layers have been worn off of the crest of the arch and remain in sight only on its flanks, thus exposing the older strata in the core of the upfold to a greater or less degree.

An excellent illustration of an arch that has thus been "unroofed," is seen north of Aix in the rising south end of Mt. de Corsuet (Exc. 2), about as shown in Fig. 4. It is evident that if the strata thus exposed in the core of an arch are weak, they will be more rapidly removed than the resistant rocks in the flanks; in such case, a single arch will be converted into two lateral ridges, separated by an axial valley. To picture the progress of these changes constitutes a good exercise in the study of mountain carving.

Topographic Inversion of the Subalpine Ranges. As advance is made eastward from the Jura ridges to the higher ranges of the Alps,

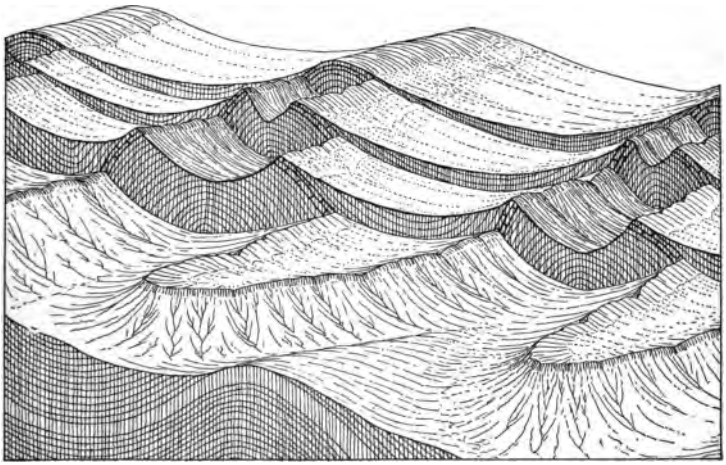


FIG. 5. TRANSFORMATION OF DOWNFOLDS INTO CANOE MOUNTAINS

the amount of erosion rapidly increases, evidently because the greater uplift that has there taken place has placed the uplifted mass

in a more perilous position: for the higher a mountain mass is raised, the steeper are the slopes on its flanks, and the more active are the processes of erosion in attacking and removing it. For this reason the higher arches of the subalpine ranges in the Bauges have been much more demolished than the lower arches of the Jura mountains.

The original upfolds of the subalpine ranges, shown in an early phase of moderate erosion in the background block of Fig. 5, have been not only completely stript of the uppermost weak strata (Miocene), but have past through the phase of narrow axial unroofing shown in the narrow middle blocks, and have reached the phase of profound excavation along the weak layers in the core (lower Cretaceous and upper Jurassic) of the unroofed upfold, as in the broad foreground block: thus each original upfold or arch is converted into so deep and wide a valley that the resistant strata (Urgonien), which for a time formed flanking ridges on each side of the narrowly unroofed upfold, are reduced to form the rims of "canoe" mountains along the axes of the originally downfolded troughs; and the trough rims are now higher than the deeply excavated arch-cores. Evidently, the explanation of the Bauges ridges is a more advanced problem than that of the Jura.

The two subparallel (Urgonien) ridges of the Mtne. du Charbon like the higher (Urgonien) ridges, Fig. 6, enclosing the headwater valley of the Chéran (Exc. 10), as well as the ridges, Fig. 7, of the double canoe (Urgonien and upper Jurassic) in the south part of the Bauges (Exc. 11), taken with the neighboring depressions, illustrate various stages in the remarkable transformation of original upfolds into valleys of erosion, and of original troughs into residual mountain ridges. Here one may exclaim with the Psalmist: "the valleys sink away in the places appointed for them." It would be as inappropriate for a mountain climber to cross the ranges of the Bauges without recognizing the topographic inversions of these deformed structures and the long history of deposition, deformation, and denudation that they attest, as it would be for a traveller in Rome to regard the delapidated Colosseum as a complete structure, and to pass it by without a thought of the gladiators who fought and of the martyrs who died upon its arena.

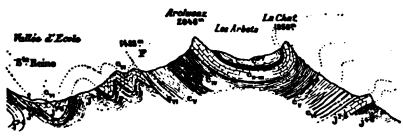


FIG. 6. SECTION OF CANOE MOUNTAIN AT THE HEAD OF THE CHÉRAN

The Deeply Eroded Central Ranges. The principle announced at *the beginning* and applied in the remainder of the preceding section

finds further application in the lofty central ranges of the Alps, where upheaval has been so great that the upper members of the

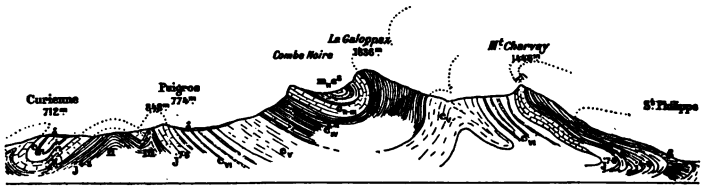


FIG. 7. SECTION OF A DOUBLE CANOE MOUNTAIN IN THE SOUTHERN BAUGES

stratified series, which form the whole bulk of the ranges in the Bauges, have been almost wholly removed, except for closely pinched downfolds, and where the more resistant lower members and the still more resistant crystalline foundation rocks have been laid bare in lofty summits. Here the uplifted areas still retain a large measure of their height of upheaval because they are strong; and curiously enough, here where the mountains are highest, the lowest members of the geological series are to be seen.

Partly because of the great structural disorder of the central ranges, and still more because of the prevalent absence of alternating hard and soft layers, the long lines of clift ridges between rectilinear, longitudinal valleys, by which the subalpine ranges are characterized, are seldom seen in the higher mountains; there forms of greater irregularity prevail, as in the chain of Belladonne (Exc. 14), in the great mass of the Pelvoux (Exc. 17), and in the dominating chain of Mt. Blanc(Exc. 20, 28). Had the foundation rocks of the upheaved central ranges been weak, they would have been deeply worn down, like the axial weak-rock valleys of the Bauges; but they are strong as well as greatly upheaved, and they therefore still retain a great measure of their initial height and surmount their less uplifted or less resistant neighbors.

Piedmont Depositories of Mountain Waste. A great part of the detritus that is removed by streams during the deep carving of a lofty mountain system, is commonly laid down in extensive deposits of gravel and sand forward from the mountain base, forming piedmont plains; the remainder is washed farther down stream to be deposited on the nearest sea floor; thus the loss of the mountains is the gain of the lowlands and the ocean. The geological history of

the earth includes a long succession of changes of this kind; building up and tearing down seems to be the order of nature.

The broad plain of the Po in northern Italy (Exc. 27) is the best illustration of such a depository of mountain waste in connection with the Alps: there the mountain foot plain has aptly given its name to the political province of Piedmont. Other examples of the same kind are mentioned below.

Alternations of Deposition, Deformation, and Denudation. The explanations of the preceding paragraphs imply that the three chief processes of mountain making follow one after the other; but closer study shows that they are to a certain extent interleaved. Before the entire series of stratified rocks, above described, was deposited, deformation had begun, and this preliminary deformation set the processes of denudation at work. The detritus thereupon taken from the uplifted areas was spread out in piedmont plains or marine strata along the mountain borders of that time. Then deformation set in again, intensifying the folding and increasing and extending the upheavals previously begun; thereupon denudation of the mountain area was accelerated, the valleys were cut down to greater depths than before, and the piedmont plains were built up to greater thickness and spread out to greater area. At one time the forces of deformation would invade a piedmont area and crumple the waste deposits that had previously accumulated there; at another time a border belt that had been more or less crumpled and denuded would be depressed and buried under later deposits of waste from the mountains.

The latest members of the stratified series in the Aix district exemplify some of these complications. The uppermost strata do not lie smoothly or "conformably" upon the unworn surface of the next underlying formation, but unconformably upon the moderately deformed and eroded surface of several older and underlying formations (upper Cretaceous), as may be seen in the district south of Yenne (Exc. 6, 7) and elsewhere. Hence deformation must have invaded this district, interrupting deposition and introducing denudation for a time (Eocene), and only after this period of disturbance and erosion was followed by a movement of depression did deposition begin again by the accumulation of the latest members (Miocene) of the stratified series in the Aix district and far northeastward through the Swiss foreland between the Alps and the Jura.

While the latest strata were accumulating, partly as marine deposits, partly as river-laid piedmont deposits, their surface was as smooth as the silt-covered bottom of the northern Adriatic or as the piedmont plain of the Po is today; but in time deformation again invaded the region; the folding, previously begun, was intensified, and the last-laid deposits were then crumpled with the rest. Thereupon the processes of denudation, which had been continuously in operation in the central Alps, attacked the newly deformed and upfolded marginal area; the

topography of the region as we see it is chiefly the product of this relatively late chapter of erosional development.

The latest crumpling did not extend westward all across the area of previous piedmont deposition, for the low uplands that stretch from the westernmost Jura ranges to the Rhone (Exc. 15, 16) consist of undisturbed (Miocene) strata of age similar to those that occupy the downfolded troughs between the Jura arches near Aix; indeed the western uplands are in part capt by still younger (Pliocene) beds of river-laid mountain waste — sands, gravels, and cobbles — which while accumulating undoubtedly formed a smooth piedmont plain, sloping westward; and it was probably the relatively rapid growth of this deposit, supplied by Alpine torrents which had been invigorated by the latest upheaval and crumpling of the high mountains to the east, that pushed the Rhone to its present course, close along the base of the Central Highlands. Today, however, the uplands are not a smooth piedmont plain but a succession of hills and valleys: hence it must be supposed that since their gravels were laid down, a general uplift of the region without deformation has taken place, in consequence of which the piedmont plain has been dissected into its present uneven surface. As the earlier-made piedmont plains west of the Alps have now lost their smooth form of accumulation, not they but the later-made and still smooth plain on the Italian side of the Alps was instanced above as a typical example of a piedmont depository of mountain waste.

Three Phases of Mountain Carving. The progress of denudational processes in carving the Alps into their present mountainous form has, as noted above, received impulses of reinvigoration whenever the uplift of the mountain region was renewed. It must now be added that, after the last (Pliocene) great uplift of the region, an extraordinary expansion of the mountain glaciers took place during the so-called glacial (Pleistocene) period, and that the expanded glaciers, acting as very effective eroding agents, modified the forms of the mountain and valleys, previously carved chiefly in the ordinary fashion by weather and water, to a very striking extent. It thus becomes desirable to examine in some detail three successive phases of mountain carving, namely, the preglacial, the glacial, and the postglacial phases, in order to assign the existing features of Alpine topography to their proper cause.

Preglacial Erosion by Weather and Water. It is eminently possible that the lofty central Alps were high enough in preglacial time, as they still are in postglacial time, to receive an abundant snowfall and to bear glaciers of moderate size, and that the highest ranges then as now owed their form largely to erosion by weather and ice;

but the greater part of the Alpine region seems, like many other mountain regions, to have been carved in preglacial time chiefly by the ordinary or "normal" agents of weather and water, and to have been subjected to glacial conditions only for a comparatively short geological period. During this period the extension of the glaciers does not seem to have been due to an increase in the altitude of the mountains, but to a moderate refrigeration of atmospheric temperatures, as a result of which many mountainous regions in the cool-temperate latitudes of the world were simultaneously glaciated.

The preglacial Alps must therefore be conceived as having forms for the most part similar to those which are now seen in mountains of warm-temperate latitudes that have never been glaciated; for example, the Black mountains of North Carolina and the southern ranges of the Rocky mountains in New Mexico. The characteristic features of such mountains is the perfect development to which their drainage system has advanced, as a result of the long uninterrupted action of the ordinary or normal processes of erosion Every down-hill line on the mountain sides is the path of a well organized, slowly-creeping stream of weathered rock-waste; all the adjoining lines coalesce to form a sheet of creeping waste by which the underlying rock is everywhere cloaked, except that where an extra resistant stratum overlies a moderately resistant stratum, a bare cliff may remain unsubdued. Under such conditions, mountain tops are worn to dome-like forms, and their slopes and spurs are smoothly rounded with few lines of detail, as in Fig. 8. Great domes of this kind have altitudes of 10,000 or 12,000 feet in the southern ranges of the Rocky mountains. They have great simplicity and dignity of form, but they lack diversity of detail and offer few lines for sketching.

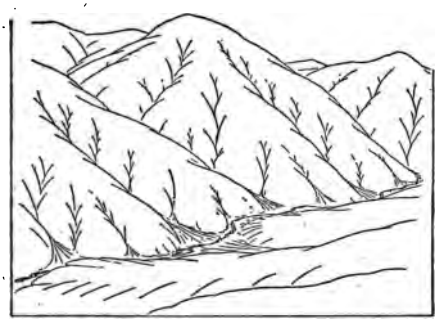


FIG. 8. DOME-LIKE MOUNTAINS OF NORMAL EROSION

more readily excavated than the more resistant adjoining rocks. On these well selected courses all the many streams that unite to form a river have worn down their channels to lines of regularly decreasing slope from the rapidly-falling headwaters to the almost level lower courses; waterfalls are absent, except for little cascades and ripples that may still remain, not yet completely smoothed out, near the stream heads. Moreover the streams run down their well regulated channels in such volume and with such velocity that they are just about able to sweep along the waste that is intermittently washed into them by the surface rills of rainy weather, and that is continuously but very slowly fed into them all along their course by the steady but very deliberate down-hill creep of the rock waste on the valley sides.

Nowhere is the organization of a river system in a never-glaciated mountain region more strikingly manifested than at the confluence of two of its members; their declivities are so nicely adjusted for miles above the point of junction that, when they join, their confluent surfaces come together at the same level. The same is true of the two valley floors along which the confluent streams flow: they join each other at accordant levels, even though the slant by which the valley floors descend to the point of junction may be steeper in one valley than in the other. It has been understood for a century past that where relations so systematic as these obtain, the valley floors must have been worn down by the streams that drain them: no other agency could have developed so perfect an adjustment.

It should be pointed out, however, that although the valley floors and the stream surfaces of a maturely organized river-and-valley system thus join one another at accordant levels, the beds of the stream channels must come together at discordant levels, if the streams are of different size. A small brook is not so deep as the large river that it joins; and even though the water surfaces and the valley floors of the two come together at accordant levels, the shallow bed of the brook is not so low as the deeper bed of the river: if the water were drained away, the brook bed would be seen to " hang " above the river bed.

There can be little question that the preglacial Alps had for the most part normally rounded summits and smoothly graded, soil-cloaked slopes — except where strata of strongly contrasted resistance formed cliffs — and that their valley systems had attained the advanced or mature stage of development in which the streams flow along their floors with regularly decreasing declivity from head to mouth, all the streams being so nicely adjusted to one another

that their junctions were always at accordant levels. This inference must be emphasized, for if the traveller in the Alps has not learned the normal characteristics of maturely developed mountain forms and their maturely developed river-and-valley systems by the observational or other study of never-glaciated mountains, he may make the serious mistake of regarding the peculiar features of Alpine mountains and valleys as the products of normal erosion, and thus fail to recognize them as the special products of glacial erosion. If so, he will lose one of the greatest interests of an Alpine journey.

Former Great Extension of Alpine Glaciers. The former extension of Alpine glaciers far beyond their present limits is proved by the occurrence of striated rock surfaces and transported or "erratic" boulders. The striated surfaces of many rock ledges, situated far down the valleys from the present glaciers, are precisely like those seen beneath the margins of existing glaciers, where they are produced by the scouring of the bed rock by sand and gravel, dragged along under heavy ice-pressure. The boulders of crystalline rocks, often perched high on the slopes of the subalpine limestone ranges, and on the crests of the Jura mountains beyond the Swiss foreland, must have been transported on ice from the central ranges of the Alps, just as similar boulders are borne shorter distances on present-day glaciers. There is, moreover, an abundance of ice-dragged detritus of mixed origin, unstratified and firmly packed on the valley floors; and terminal moraines, left at the farthest advance of the ice (Exc. 15, Pays de Dombes) or at halts during its retreat (Exc. 16, near Voisons) also indicate the great extension of the ancient glaciers.

The distribution of striated rock surfaces and erratic boulders has long been studied, and is now known so well as to demonstrate that the glaciers of the Alps were formerly of much greater size than now. They were thick enough to fill the main valleys to depths of 1000 m. or more, and long enough to extend even beyond the margin of the Alps upon the lower piedmont lands. In the neighborhood of Aix, all the valleys were occupied to so great a depth by ice from the lofty central ranges, that only the higher parts of the subalpine ranges and occasional crests of the Jura arches were not covered. Glacial striations may be found in the Col du Chevelu, showing that the ice there overflowed the ridge of the Mt. du Chat (Exc. 4), although its higher part farther south remained ice-free. The crest of the Mtne. du Grand Colombier (Exc. 8) was also above the ice limit, but the arch of the Gros Foug next to the east, and the lower land between that mountain and the Alps were ice-covered.

The search for boulders of crystalline rocks, derived from the central Alps, adds much interest to the exploration of these limestone ridges.

Interesting and significant as striated rock surfaces and erratic boulders are, they are not striking elements of the landscape: in respect to visibility they are far exceeded by certain large and conspicuous topographic features, which also owe their origin to the action of the ancient glaciers. It may indeed be truly said that the Alps owe a large part of their picturesqueness, directly or indirectly, to the work of ice, as will now be more fully explained.

It may be noted in passing that the expansion of Alpine glaciers took place not only once but several times; thus the glacial period may be divided into successive glacial and interglacial epochs—the latest interglacial epoch must have been of longer duration than the present postglacial epoch. But it is not possible to pursue these details here.

Resemblances and Contrasts of Glaciers and Rivers. The interesting problem of the sculpture of mountains by glaciers may be entered from either the observational or the inferential side. As those who carry this guide book with them will have abundant opportunity of entering the problem observationally, especially if they ascend some of the higher valleys (Exc. 14, 19, 20, 27, 28), the subject will here be presented inferentially. Let it therefore be understood that glaciers and glacier systems bear certain striking resemblances to rivers and river systems, particularly to rivers that, heading in rainy mountains, flow down to arid deserts and wither away without reaching the sea. They are both fed from the atmosphere, the first chiefly by snow, the second chiefly by rain. They both flow down hill, faster along mid-channel than near the channel banks or bed; but glaciers flow very sluggishly, while rivers flow very nimbly. Hence a sluggish glacier, fed by a given amount of snowy precipitation on a mountain slope of a given area, will have a vastly larger cross-section than that of a nimble river, fed by the same amount of rainy precipitation on the same area of mountain slope; the trough occupied by a slow-creeping, heavy glacier is a large part of its valley; the channel occupied by a fast-running, slender river is a very small part of its valley.

The slender current of a river is confined within its valley by the side slopes; the heavy current of a glacier may overtop the valley-side ridges and thus give forth out-flowing branches or distributaries into adjacent valleys; this may frequently be the case where a large glacier overflows the foothills of a mountain range on its way to the piedmont lowlands. A river receives most of its load of rock-waste from the wash and creep of the detritus down the slopes of its valley head and sides, which rise high above its channel; thus armed, it rasps some more detritus from its bed, but the amount thus added is a small part of the total load. A glacier also receives some of its load of rock-waste from the creep and fall of detritus from the mountain slopes that rise above it; but its heavy

mass scours and plucks a large share of detritus from the floor and sides of its great trough, and drags it slowly down stream.

The Sculpture of Mountains by Glaciers. If we now assume that a glacier system is capable of eroding the surface down which it creeps so heavily, we should expect that great quarry-like cavities would be excavated where the granular ice accumulates in the upper reservoirs; as the cavities are broadened and deepened, the slopes above them would be sapped and steepened by the active rock splintering and detrital creeping induced by the many alternations of freezing and thawing that take place on mountain tops. Hence under the influence of a glacial climate rounded mountain tops would be sharpened and somewhat lowered, as in Fig. 9; thus the simple rounded forms of never-glaciated mountains should gain serrated profiles along their crests and many details of ledge and crevice on their slopes, whereby their picturesqueness is greatly increased. Furthermore the branch and trunk glaciers should scour out troughs of appropriate size; and as the troughs are deepened and widened, the slopes above them would be undermined and steepened, and the spurs that descend into the troughs would be cut off, as is also shown in Fig. 7. Finally, the waste products of this erosive work should be laid down in firmly packed, unstratified deposits near the glacier end, where its thickness, its pressure, its rate of creeping, and its scouring and dragging power are all decreased; a good part of the waste should be washed forward by outflowing ice-water streams.

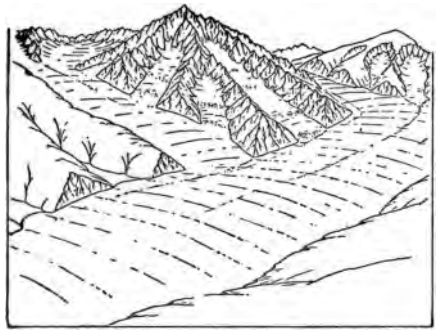


FIG. 9. SHARPENED PEAKS OF GLACIATED MOUNTAINS

Time must be a factor in the erosive work of glaciers, as it is in that of rivers. A long-lasting period of snowy climate would permit the resulting glaciers to enlarge the quarried cavities of their upper reservoirs and *the troughs of* their trunks to great dimensions. On the other hand, if a

change to a less snowy climate should sooner intervene, the forms of the reservoir cavities and of the trunk troughs would be imperfectly developed. The correctness of these various assumptions may be estimated by the degree to which they are borne out by observed facts; but before turning to that side of the problem, certain additional and highly significant resemblances between river channels and glacial troughs must be pointed out.

River Channels and Glacial Troughs. A well developed river channel has comparatively even sides; likewise a well developed glacial trough ought to be comparatively smooth-sided. The bed of a river channel is by no means so even as the river surface; it has occasional sills where hard rocks are not completely worn down, and there the river has a more hurried flow; it has pools and shoals of greater and lesser depth, the deepest pools usually being found where weak rocks occur: if the average depth of a river be 8 m., it may be lessened to a quarter of that measure on hard-rock sills, and increased to double measure in weak-rock pools. Similarly, the bed of a glacial trough need not be as even as the glacier surface: if the glacier have an average depth of 600 m., it may be reduced to 400 m. on a hard-rock sill, and there the fall of the glacier surface and the rapidity of the ice movements will be locally increased; or the depth may be increased to 700 or 800 m. where the trough bed is easily excavated in basin-like form in weak rocks. The differences between river channels and glacier troughs are therefore more a matter of dimensions than of kind.

A still more remarkable resemblance remains to be mentioned. It has been stated above that, although a narrow brook and a broad river have accordant surface levels at their junction, their beds will not be at the same level. Likewise, although a small branch glacier and a large trunk glacier may, after their troughs are well developed, come together with accordant surfaces at their junction, the bed of the branch trough will not be so deep as that of the main trough: if the main glacier be as much as 1000 m. deep, and the side glacier only 600 m. deep, then the side trough will "hang" 400 m. above the bottom of the main trough.

So long as rivers occupy their channels and glaciers occupy their troughs, these inequalities of depth are not open to direct observation; but if a river dries up, as commonly happens during part of the year in arid regions, or if a glacier melts away, as gradually happens when a cold-temperate climate changes to a warm-temperate climate, all

details of form in the channel or the trough will be laid bare. A deglaciated mountain system should be expected to exhibit such features as are outlined in Fig. 10. Here the evacuated glacial troughs will commonly be called "valleys," and the discordance of level between the floors of a side trough and its main trough will be conspicuous; thus the side troughs come to be called hanging lateral valleys.

Postglacial Changes. After the disappearance of the ancient glaciers, the ordinary processes of erosion by weather and water would be reëstablished, and would at once set to work to develop once again the well graded forms that had prevailed in preglacial time. Where steep cliffs had been formed by glacial erosion, as around the heads of the upper reservoirs and along the sides of the troughs, rock fragments, detached from the upper parts, would fall and accumulate as a talus in front of the lower parts; thus the steepness of the cliff would be reduced. Where rock-basins had been excavated in trough floors, they would first be filled with water as lakes, and then gradually filled with stream-borne rock waste and converted into meadows.

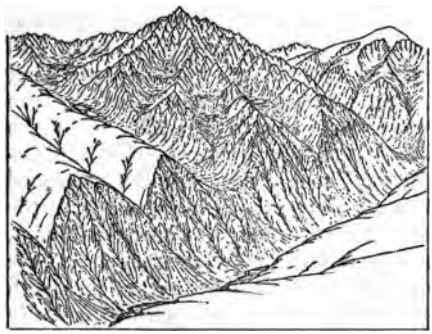


FIG. 10. THE HANGING SIDE VALLEYS OF DEGLACIATED MOUNTAINS

Indeed, even if no basins were excavated, a trough floor might have been so greatly degraded or overdeepened by glacial erosion that the postglacial stream, little accelerated on so faint a slope, will not be able to sweep along all the detritus received from its headwaters and branches: then some of the detritus will be laid down, and the trough floor will be thereby built up or aggraded to a steeper slope, on which the stream will be given velocity sufficient to sweep along the remainder of its load.

Where lateral troughs or valleys hang above an overdeepened main trough, streams will cascade from them, cutting chasms in the upper part of the main trough wall and spreading out fan-cones of detritus on the trough floor; the main stream may be pushed against the farther side of its trough by the forward growth of such fans. In the piedmont districts, where the ancient glaciers acted rather as depositing than as eroding agents, the accumulation of subglacial detritus or the building

of submarginal moraines may obstruct preglacial valleys: then the postglacial streams may be constrained to take new courses, along which they will cut chasms and gorges where their fall is rapid. The amount of progress in these changes will indicate the time since the final retreat of the ancient glaciers.

Alpine Features of Glacial Origin. All the topographic features ascribed to glacial action in the foregoing paragraphs have their counterparts in the Alps as well as in many other lofty mountains, formerly glaciated and now deglaciated. The lofty central summits have been sharpened by the retrogressive erosion of the upper ice-reservoirs, as in Fig. 11. The Meije, an almost inaccessible "needle" in the Pelvoux group (Exc. 17), and many other similar forms are thus to be explained. So extensive has such retrogressive erosion been that arched remnants of preglacial domes, as drawn in the background of Fig. 10, are seldom seen; but it is significant that Mt. Blanc, although encroached upon by huge excavations on all sides, still has a rounded top: part of the measure by which it overtops all other mountains in the Alps is therefore to be ascribed to its not having been lowered by glacial sharpening.

FIG. 11. A SHARPENED ALPINE PEAK EAST OF THE VAL D'OISANS

The enlarged upper reservoirs of ancient glaciers are known in the Alps where French is spoken as "cirques," because of the steep rock

walls by which their slanting floors are enclosed. The ridges between adjacent cirques are reduced to narrow serrate ridges known as "arêtes"; in some cases they are nearly or quite worn away, allowing the adjoining cirques to become more or less confluent. The cirque floors are frequently excavated in small rock basins, holding lakes: the best examples of this kind near Aix are the "Sept Laux" in the chain of Belladonne, a visit to which (Exc. 14) is therefore commended. The neighboring range of the Grandes Rousses, as seen from the Rocher-Blanc on this excursion, exhibits many of the features here described. Similar features are to be seen in the rocky wilderness between the headwaters of the Isère and the Arc (Exc. 19), and in all the high mountains that adjoin the passes by which the Franco-Italian frontier is crossed (Exc. 18).

FIG. 12. HIGH HANGING VALLEYS WEST OF THE VAL D'OISANS

The forward slope of the cirque floors is often broken by rock steps, as if the duration of glacial erosion had not been long enough to reduce them to an even grade; the slope leads down into short trough valleys of steep pitch, which usually hang, as in Fig. 12, at a surprising height above the oversteepened walls of the overdeepened main trough valley to which they are tributary. The spurs between the hanging troughs or side valleys are truncated in great cliffs that continue downward in the oversteepened walls of the main trough. The larger the drainage area of the side trough in relation to that of the main trough, the less the discordance of their floors: a discordance of moderate measure is shown in *Fig. 13.*

The international railway that enters the mountains from Turin on the way to France has, on approaching Susa, to climb obliquely up the oversteepened south side of a main trough (the valley of the Dora Riparia, Exc. 18, 27) in order to reach a hanging side valley, which is then ascended nearly to its head: those who visit this picturesque district by railway should if possible leave the train at Chiamonte, 752 m., near the mouth of the hanging valley, and descend on foot NE 6 k. to Susa, 495 m. The famous Mer-de-Glace at Chamonix (Exc. 20, 28), occupies a side valley which hangs several hundred meters above the main Chamonix trough; the railway from Chamonix to Martigny descends into the valley of the Rhone from a hanging lateral valley. Hanging side valleys are, indeed, quite as characteristic of the Alps as sharpened peaks and valley-head cirques: yet thousands of visitors to Chamonix fail to recognize anything peculiar in discordance of the hanging side trough, now occupied by the Mer-de-Glace, with respect to the much deeper main trough.

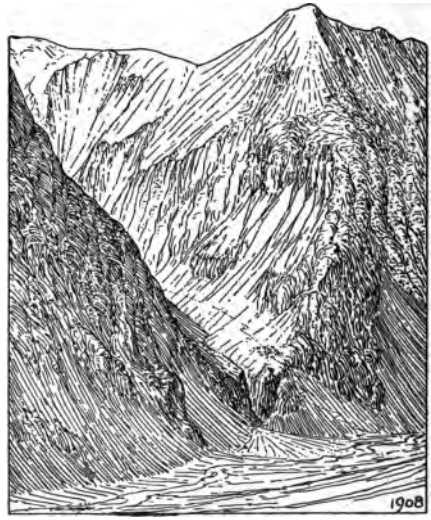


FIG. 13. A LOW HANGING VALLEY LATERAL TO THE VAL D'OISANS

The larger valleys that lead out from the Alps all exhibit in a more or less striking manner the characteristic features of overdeepened glacial troughs with oversteepened walls, in which hanging side valleys and truncated spurs may be counted in abundance. Some of the hanging side valleys near the margin of the mountains bear no marks of having been occupied by branch glaciers: these valleys hang above the main valley because the latter has been not only deepened but also widened by glacial scouring.

Outgoing glacial branches, or distributary glaciers, have left their marks wherever the surface of a trunk glacier rose above the level of a valley side col: thus the trunk glacier of the Isère gave forth a double

distributary at Albertville and the Col de Tamié (Exc. 12), which deepened a preglacial valley into a good trough past Faverges, and excavated a basin in the trough floor where Lake Annecy now lies. In such a case, it should be evident that the depth of the lake now occupying the basin is not a measure of the depth of glacial erosion, but only a measure of the excess of erosion in the basin area as compared to the erosion farther down stream. Another distributary of the Isère glacier overran the preglacial col of the Chambéry breach, wore it down, and excavated the basin which holds Lake Bourget: it was this Chambéry-Bourget distributary which overflowed the less elevated parts of the Jura arch known as the Mtne. de l'Epine, Mt. du Chat, etc. (Exc. 7, 4, 5).

Those who ascend the Chéran past Le Chatelard and Ecole (Exc. 10) may there find erratic blocks from the upper Isère, thus proving that the trunk glacier of that great trough overflowed the Col du Frène and crept down the central valley of the Bauges; but the volume of this overflow could not have been great, as the valley of the Chéran is not greatly modified. The view from the col into the present valley of the Isère gives an impressive measure of the thickness of the ancient ice-stream. The Faverge, the Col du Frène, and the Chambéry distributaries all became confluent with the broadly outspread glacier of the Rhone, which, after passing through an overdeepened stretch now occupied by Lake Geneva, was reënforced by the glacier of the Arve from Mt. Blanc and covered all the foreland between the Alps and the Jura hereabouts.

After the main Isère glacier turned NW at Grenoble, it again divided: one branch continued down the Isère valley to the SW; the other continued W down the valley of Bièvre (Exc. 16). All of these glaciers left more or less detritus, commonly spoken of as glacial drift, packed upon the trough floors and sides near the mountain margin and upon the lower land beyond, as may be seen at many points in the distributary trough near Chambéry and Aix. Terminal moraines of the Isère glacier in the latest glacial epoch are well developed dear Voisons (Exc. 16); others of an earlier epoch are found some 25 k. farther W in the Bièvre. A young moraine of the Rhone glacier may be followed along the W side of the marshes that lie between Lake Bourget and Culoz: a much older morainic area, formed by the earliest advance of the Rhone glacier, which far exceeded its later advances, constitutes the Pays de Dombes, between Bourg and Lyons (Exc. 15).

Postglacial Features. Changes due to the action of normal erosional processes on features of glacial origin are everywhere manifest; but it is noteworthy that the work they have as yet done in reëstablishing normal forms is small compared to that done by glacial erosion in destroying the normal forms of preglacial time. The acute peaks and the serrate ridges must in time be dulled and *rounded, but their forms* are still strikingly sharp. The steep cliffs

of cirques walls are accumulating talus or scree at this base, but the cirques are still manifest features. The rock basins of cirque floors are diminished or filled by accumulating detritus, but the basins are still manifest. The rock sills of cirque-floor steps are notched by rasping streams, but the sills are still visible.

Likewise, the oversteepened side walls of overdeepened troughs yield much detrital material which accumulates in stony slopes at their base, as along the west side of Lake Bourget, but the trough walls are still steep. Sometimes the oversteepening of the walls has left them unstable; then landslides occur, as at the Abîmes de

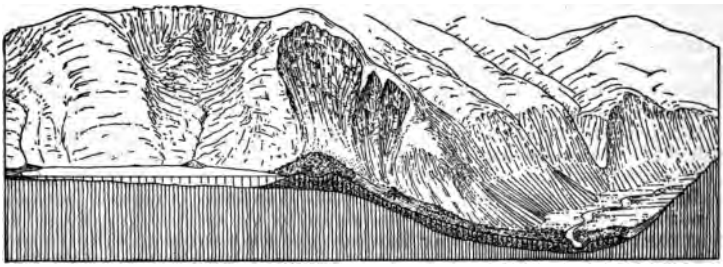


FIG. 14. A LAKE HELD IN A HANGING VALLEY BY A LANDSLIDE

Myans (Exc. 12): in a branch of the Romanche valley, east of the Val d'Oisans (Exc. 17), a landslide has blocked the mouth of a hanging side valley and formed a small lake, as illustrated in Fig. 14. Chasms or gorges are cut where streams plunge down from hanging side valleys floored with hard rocks, and detrital fans are formed in the main trough or valley below, but the discordance of depth between side and main valleys is usually a striking feature.

Many examples of this kind are to be seen along the inner valleys of the higher Alps: for instance, on the main railway line to Italy, one may stop at La Chambre on the Arc, 25 k. S of its junction with the Isère; here several hanging side valleys, E of the main valley, may be seen to best advantage by crossing to the other side of the valley by the river bridge near the railway station, 460 m., walking SW 1.5 k. to the village of St. Etienne, and then ascending NW 1.5 k. to a well placed point of view, 850 m., on the top of a truncated spur. Many other examples of postglacial gorges beneath hanging valleys are found where the chain of Belladonne descends northwest to the great trough or valley of the

Graisivaudan; their general relations are well displayed in the extensive view from the Granier (Exc. 13); the gorges and the villages beneath them deserve a closer view, such as the road along the valley side affords (Exc. 16, 23, 24). Along the distributary trough by Faverges (Exc. 12), where the hanging side valleys are excavated along belts of relatively weak strata, they have been so much cut down by their streams that their discordance is no longer striking. The discordance is better preserved where the chasm known as le Bout du Monde is cut by the Leisse as it descends from a hanging valley in the Bauges to the Chambéry breach (Exc. 11).

The gulches cut in the long slope of the breach side near St. Sulpice, west of Chambéry (Exc. 7), are all of postglacial origin. The slope was scoured into its concave form by the distributary of the Isère glacier that past through the breach and enlarged it, and the scoured slope was more or less veneered with firmly packed drift later on, when the distributary began to dwindle. The slope, thus shaped by the longitudinal action of the passing glacier, is now sharply trenched by its down-hill streams. The lakes that occupy overdeepened trough floors have all been more or less encroached upon by the deltas of inflowing streams. Thus the delta of the Leisse at the head of Lake Bourget is 5 k. or more in length; the delta has advanced about 200 m. since the castle of Le Bourget was built on its shore front in the twelfth century. A similar delta occupies the former head of Lake Annecy. Singularly enough, both of these lakes have been diminished by the deltas of passing rivers at their outlet ends: the Fier thus has filled the north end of the Annecy basin with alluvium, as may be well seen from the hill, west of the city of Annecy (Exc. 12b). The Rhone has transformed a much larger part of the original basin of Lake Bourget into broad marshes, well seen in bird's-eye view from the Mtne. du Grand Colombier (Exc. 8) or the Mtne. du Gros Foug (Exc. 9).

On the other hand the Fier, about 8 k. west of Lake Annecy is displaced northward by a heavy body of glacial drift from its former course in weak strata, and has therefore begun the erosion of a new valley by cutting a narrow cleft or chasm in resistant limestones, a superb example of postglacial erosion (Exc. 12a). The chasm of the Chéran, bridged by the Pont de l'Abîme at its exit from the Bauges (Exc. 11), results from the displacement of the stream from its former course by a deposit of drift. Several successive gorges which well repay a visit are cut by the drift-displaced Drac in the neighborhood of La Mure (Exc. 17, 24). Like the Fier the Rhone also seems to have taken a new course below the lake that it has partly filled, for the gorge at Yenne (Exc. 6) is so narrow that it cannot be regarded as the preglacial valley of this large river.

The survival of Lakes Bourget and Annecy from complete filling with alluvium is due to the small volume of their inflowing streams. The survival of Lake Geneva, into which the Rhone, the largest river of the western Alps, flows, is due to the great size of the lake basin. Where moderate-sized basins of overdeepened glacial troughs are entered by *good sized rivers,* they are converted into alluvial plains: thus the Val

d'Oisans (Exc. 17) has every appearance of a lake transformed into a gravel plain by the torrential Romanche: when one sees the abundant detrital deposits that slope forward from its side cliffs and cover its floor, as in Fig. 12, the appropriateness of describing this section of the Romanche valley as an overdeepened trough with oversteepened walls becomes apparent. It is similarly possible that the great trough of the Graisivaudan was once partly occupied by a lake or lakes, although it is now aggraded into a long plain by the powerful Isère.

HISTORY OF SAVOY

It was in the later stages of the long process of Alpine sculpture above described that man appeared upon the scene. The region seems to have been occupied by living beings of lower orders ever since it was upheaved above the level of the sea, for the successive piedmont deposits accumulated during the slow deformation and denudation of the Alps contain as fossils many species of plants and animals that lived in fresh water or on land. That long stretch of time was made up of days and years by the million, with weather and seasons changing very much as they change now, with landscapes apparently as everlasting as they still are and yet in reality all on the ceaseless march of progress from the past into the future. Today was always the moment of reality, with yesterday forgotten and tomorrow unknown. Earthquakes may have increased in number and in violence during epochs of mountain making, just as snow fields were larger and ice streams longer during the glacial period than before or after; but there is no reason to think that the order of change by which the face of nature alters its expression ever varied greatly from the slow progress that we so often mistakenly regard as finished and fixed.

Not until the mountains had nearly assumed their present form is there any record of human inhabitants. The first relics of man are stone implements, found in piedmont gravels and in cavern deposits that contain also the bones of various mammals long extinct in Europe — horse, elephant, mammoth, rhinoceros, etc. — and that are associated with the outwashed gravels of the later glacial epochs. Since then man appears to have been continuously present and continuously advancing, for his implements and weapons show a gradual development of better worked forms. Thus the lake-dwellers were of postglacial date and of much greater advancement in the arts than their rude cave-dwelling predecessors.

About the beginning of the Christian era, the valleys of Savoy were occupied by various tribes, of which the chief were the Allobroges, who were encountered there when the Carthaginian general, Hannibal, crossed the Alps, B. C., 218, probably by the valley of the Isère (see Exc. 14), on his way to Italy. The Allobroges were afterwards conquered by the Romans when they invaded the region: relics and inscriptions of this comparatively civilized period abound, and are to be seen along with more ancient artefacts in the museums of Aix, Chambéry, and Annecy.

Many villages and cities of today date from Roman times. To an American, coming from a country lately entered upon by colonists of many nationalities, nothing is more impressive than the manifold signs of long-continued settlement by people of the same stock, here to be seen on every side. The villagers are in large proportion the descendants of long lines of local ancestors; for though a good number of Savoyards have emigrated to other parts of France and to more distant parts of the world, few outsiders have come here to make their homes. The customs of the peasants in the inner valleys show that close adaptation to the forms of the land, the climate and the soil, which comes from centuries of unchanged seclusion.

In common with many other mountain peoples, the peasants of Savoy drive their flocks up to the higher valleys and on to the mountain slopes for the summer, and down into the lower valleys for the winter: to them, the "montagne," like the "alp" in Switzerland, is not the lofty and barren summit of rock and snow, but the slope at mid-height to which they mount as soon as the winter snows are replaced by grass and flowers. Thus a good share of the population practise "transhumance": they have a mountain home during the warm season of active outdoor work and a valley home during the cold season of quiet indoor living. The paths that they follow forth and back have been followed for generations; the fairs that are held in the larger villages after the flocks are driven down from the highland pastures are long established institutions.

Through the Middle Ages when the land belonged to its rulers, the Counts of Savoy had their seat at Chambéry, a stronghold placed at the narrows (Exc. 11) of the open breach between the broad valley of Graisivaudan on the southeast and the trough of Lake Bourget *on the northwest.* Their possessions were gradually increased by

conquest or by marriage, and in time they acquired territory on the Italian side of the Alps: then one of them as Duke of Savoy transferred his capital to Turin in 1577. After further growth of power, they took the title of king in 1720, still retaining Savoy as one of their provinces. The road that led from Chambéry over the Col du Chevelu (Exc. 4) northwestward to Lyons then gained the name, " Route de France," which it still preserves.

In after years, the province of Savoy was incorporated into France in 1792, and so remained until the defeat of Napoleon at Waterloo allowed its return to Italian domination. Later in the nineteenth century when the people in various parts of the Italian peninsula were struggling for independence and freedom, they were led by Victor Emmanuel II of the House of Savoy, who thus became King of Italy in 1861: but in recompence for aid given at that time by Napoleon III in driving the Austrians out of Lombardy, Savoy was ceded to France in 1860, and the cession was confirmed by an almost unanimous vote of the people. The Abbey of Hautecombe on Lake Bourget where many princes of the House of Savoy were buried (Exc. 5), is still retained under Italian protection. Thus the ancient province, extending 150 k. southward from Lake Geneva beyond the valley of the Arc, and 100 k. westward from the crest of the Alps to the great V-bend of the Rhone, became a part of the country to which it has always been geographically related.

Many changes have taken place in the province of Savoy in the last hundred years. Rapid transportation by railway has largely replaced slow travel by stage. The lofty mountains, never ascended by the peasants of the Middle Ages, have been accurately mapped as a military necessity and explored as a pastime. Thousands of outsiders now visit Savoy every summer, for tens in earlier centuries; and as if in compensation for the summer visitors, thousands of Savoyards spend the winter at work in the outer world while their valleys are snow-bound. As a consequence many local customs of an earlier time have fallen into disuse. Manufactured goods, brought in from great industrial cities, replace home products, and the picturesque local costumes of the inner valleys are largely abandoned. Education is more general now than formerly, and newspapers and books come in abundantly from the outer world; hence the local patois, hardly intelligible even to a Frenchman, is giving way to

the standard language of France. The great water powers of the hanging lateral valleys, which for ages did only their own work of carrying the detritus from the mountains down to the rivers, are now compelled to work for man in huge electrical plants, which attract a new industrial population from the piedmont country. Thus changes take place at an increasing rate: but of all the modern events that Savoy has witnessed, none can compare in historical import with the arrival of soldiers by the thousand, members of an army a million strong, brought from a country beyond a wide ocean to fight for peace without conquest. May they find vigor in the southern mountains, with which to go back to their great task of winning victory on the northern plains!

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